I. FOLSOM DAM ENLARGEMENT PLAN ALTERNATIVES: ANALYSIS AND RECOMMENDATIONS

AMERICAN RIVER WATERSHED INVESTIGATION

AUGUST 2001

TABLE OF CONTENTS

LIST OF APPENDICES

I. INTRODUCTION

The American River Watershed Investigation (ARWI) Long-Term Study is intended to supplement the 1991 Feasibility Report and the 1996 Supplemental Information Report prepared by the Corps of Engineers (Corps). The Long-Term Study has a primary purpose of evaluation of two basic alternatives: modify levees of the Lower American River and enlarge Folsom Dam, in accordance with Congressional direction from the Water Resources Development Act (WRDA) 99, and to provide a recommendation on further Federal action (USACE 2000).

This section provides: (1) the Fish and Wildlife Service's (Service) analyses of impacts to fish and wildlife that would result from construction and operation of the various Folsom Dam raising alternatives; (2) recommendations to avoid, minimize, rectify or, as a last resort, compensate these impacts; and (3) the Service's assessment of project alternatives based on a fish and wildlife conservation perspective. The analysis herein is based on site visits, literature review, discussions with experts, and project plans and information provided by the Corps through July, 2001.

II. DESCRIPTION OF THE STUDY AREA

a. Folsom Dam and Reservoir and the Lower American River areas

The project area is in the American River watershed, and would affect lands around Folsom Reservoir and along the North and South Forks of the American River, which are impounded by Folsom Dam, and French Meadows Reservoir (Figure 1). The project would also affect the lower American River, which is the river's reach downstream of Folsom Dam.

The American River is the second largest tributary to the Sacramento River. The three forks (north, middle, and south) of the river originate in the Sierra Nevada Mountains at an elevation of about 10,400 feet (mean sea level), and generally flow in a southwesterly direction. The Middle Fork joins the North Fork near the City of Auburn, just upstream of Folsom Reservoir; the North Fork then joins the South Fork just upstream of Folsom Dam (Figure 1). All three forks of the American River above Folsom Reservoir are nationally popular areas for whitewater sports, and the reach of the South Fork from Coloma downstream to the reservoir is the state's most popular whitewater rafting run.

Folsom Dam, located near the City of Folsom, is a multi-purpose dam built by the Corps in 1955, and operated by the Bureau of Reclamation (Reclamation). It is the largest of about 20 dams in the American River watershed and, except for Nimbus Dam, is the furthest downstream. The main dam is a 345-foot high concrete gravity dam across the American River channel. Associated with Folsom Dam is a series of auxiliary dams and dikes which span topographic lows; these structures are needed to contain the reservoir. Mormon Island Dam is the largest of these structures, and is located on the southeast end of the reservoir, in Blue Ravine. Folsom Reservoir blocks about 20 miles of the North Fork and 10 miles of the South Fork American River, and has a total storage capacity of 974,000 acre-feet, which fills the reservoir to an elevation of 466 feet above mean sea level (msl).

Reclamation operates Folsom Dam as an integrated component of the Central Valley Project (CVP). The dam's primary purposes have been to provide flood control, recreation, instream flows (to manage Sacramento-San Joaquin Delta water quality), and to produce hydropower . Dam operation has been affected by implementation of the Central Valley Project Improvement Act (CVPIA) of 1992, which expanded CVP goals to include mitigation, protection and restoration of the region's fish and wildlife. Historically, up to 400,000 acre-feet of storage capacity have been reserved for flood protection during the flood season (October through May), with the remaining capacity managed as water storage for other purposes. The 1996 WRDA authorized an interim agreement between Reclamation and SAFCA (Sacramento Area Flood Control Agency) to change the flood control storage in the reservoir to a variable space available ranging from 400,000 acre-feet to 670,000 acre-feet, depending on the amount of creditable vacant space in several existing upstream reservoirs in the basin (USACE 2000). A hydropower plant is also operated at the main dam.

The proposed project is designed to provide increased flood protection to areas which may be affected by flooding of the lower American River. The lower American River is considered the reach of the river downstream of Folsom Dam. Just downstream of Folsom Dam is Lake Natoma, formed by Nimbus Dam, which also began operation in 1955. Lake Natoma acts as a re-regulating reservoir to dampen diurnal flow fluctuations caused by operation of the Folsom hydropower plant. Releases from Folsom Dam flow into Lake Natoma (8,800 acre-foot capacity), and through Nimbus Dam into the lower American River. From Nimbus, the lower American River flows 23 miles through the Sacramento metropolitan area before joining the Sacramento River. This reach is part of the state and federal Wild and Scenic Rivers systems, and is largely administered by the County of Sacramento as the American River Parkway. The design capacity of the lower American River levee system is 115,000 cfs; at this flow, about 228,000 acre-feet would pass down the lower American River during a 24-hour period; expanding the levee capacity is being considered under another alternative for increasing Sacramento's flood protection (USACE 1994).

Historically, floods occurred almost annually in the region of the American River and Sacramento River confluence (USFWS 1991a). Much of the land in what is now Sacramento was a highly productive natural riparian ecosystem, which benefitted from frequent flooding. This ecosystem was characterized by dense riparian forest along the rivers and a complex of grasslands, emergent freshwater marsh, and woodlands in the floodplains (Thompson 1961; USFWS 1991c). The first flood control efforts in the Sacramento Region were low levees built by farmers to protect crops; by 1894 low levees had been privately built along most of the major rivers and streams in the region. The Federal Flood Control Act of 1917 authorized Federal funding for a major flood control project for the Sacramento River, which included constructing a system of canals, levees, bypass channels and weirs. These and subsequent flood control measures have enabled the conversion of highly productive wetlands and other natural habitats to agriculture and, increasingly, to urban uses.

b. Upstream Reservoirs

Most of the reservoirs upstream of Folsom Reservoir are owned and operated by local utility companies or districts. The total storage capacity of these reservoirs is about 820,000 acre-feet (USACE 1999). Only five of these reservoirs are of sufficient size or located at appropriate sites where storage space in them could have a measurable influence on flood operation. They are French Meadows Reservoir, Hell Hole Reservoir, and Loon Lake on tributaries to the Middle Fork of the American River, and Union Valley and Ice House Reservoirs on tributaries to the South Fork of the American River. Collectively, they represent 90% of the existing storage capacity upstream of Folsom Reservoir (USACE 2001). The drainage basins above the reservoirs have captured and stored a minimum of 12% of the unregulated runoff to Folsom Dam during the critical period of major flood events. The percentage of flows, and consequently the distribution of space in the upstream reservoirs which is considered for credit at Folsom Reservoir, is based on historical runoff during major floods (USACE 2000).

The maximum creditable upstream flood space has been determined by the Corps to be 200,000 acre-feet. This creditable space is divided between three of the upstream reservoirs: French Meadows (45,000 acre-feet); Hell Hole (80,000 acre-feet); and Union Valley (75,000 acre-feet). Any additional space does not benefit Folsom Dam operation during a major flood event because the drainage basins above these reservoirs do not generate significantly greater volume during the critical period of a major flood event (USACE 2000).

III. DESCRIPTION OF PROJECT ALTERNATIVES

The Corps' current evaluation for enlarging the flood space in Folsom Reservoir by raising Folsom Dam focuses on three construction alternatives in addition to no action. The no action alternative and the proposed alternatives are described below. Project descriptions are summarized from the Corps' August 1999 ARWI Information Paper (USACE 1999), October 2001 ARWI Long-Term Feasibility Scoping Document (USACE 2000), the F4 Conference and Alternative Formulation Briefing Document (USACE 2001), the Service’s 1994 planning aid report on the Folsom Dam Enlargement Plan, and from other information provided by Corps staff.

The Corps and Reclamation have determined that Folsom Dam is not currently capable of passing the probable maximum flood. Reclamation is currently evaluating measures to correct this deficiency; however, since construction is dependent on budgetary constraints, the time frame for implementation is unknown. Therefore, designs to correct the problem have been incorporated into the dam enlargement alternatives. In addition, the dam at French Meadows Reservoir has inadequate spillway capacity and contributes to the Folsom Dam safety problem.

A. NO PROJECT ALTERNATIVE

The no action alternative serves as the base against which the proposed flood protection alternatives will be evaluated to determine effectiveness and to identify effects that would result from them. Several actions that are currently authorized are expected to be completed prior to implementation of any Long-Term project (USACE 2000). Therefore, the effects and benefits associated with these actions are part of the no-action condition.

Current estimates for Folsom Dam and Reservoir and the existing levee system, are that there is about a 1 in 85 chance in any year of levee failure and flooding in Sacramento (USACE 2000, USACE 2001). The American River Common Features Project (seepage cut-off walls in portions of the north and south levees of the lower American River, some levee raising to obtain 3 feet of freeboard over the 160,000 cfs flow, raising of the east levee of the Sacramento River, and modification of the south levee of the Natomas Cross Canal) would reduce the chance of flooding from the American River in any one year to about a 1-in-100 chance. Construction of the Folsom Modification Project (new enlarged outlets and modified use of the surcharge storage space) and making the interim variable storage operation permanent, would further reduce the risk of flooding in any one year to about a 1-in-140 chance. This action would also make Folsom Dam capable of passing about 75% of the probable maximum flood (currently it can only pass 70%). Other actions to be completed are: a Folsom Flood Management Plan (improving weather forecasts based on an advanced hydrologic prediction system) which would further lower the risk to Sacramento to about a 1-in-164 chance in any year; North Area Local Project (Natomas area improvements), South Sacramento County Stream Group Project (south Sacramento/Pocket area improvements), and bank stabilization on the Lower American River under the Sacramento River Bank Protection Project (USACE 2000). The chance that the current flood control system could pass a 200-year storm without levee failure and major flooding in Sacramento is about 36% (USACE 2001).

Because Folsom Dam is a major dam upstream of a heavily populated area, it would be altered to contain 100% of the probable maximum flood. However, this work is unscheduled (USACE 2001).

Under the existing operating criteria, 400,000 acre-feet of the total storage capacity of 975,000 acre-feet is allocated for flood control. However, the Bureau and SAFCA have an interim operating agreement that allows for operation of the dam to include a variable storage space ranging from 400,000 to 670,000 acre-feet. The currently authorized Flood Management Plan update will develop an advance release operation for Folsom Dam that would be adopted as a way to gain additional flood space at little or no cost and no significant environmental damage (USACE 2001). This plan has not been fully developed or reviewed. For alternative analysis, a moderate advance release scenario was used. This scenario has a lower limit of 0 acre-feet and a upper limit of 190,000 acre-feet. The most likely release would be 100,000 acre-feet. Although advance release would use Folsom Lake's water supply space, there is at least a 97% chance that the water supply space would be refilled (USACE 2001).

B. FOLSOM DAM ENLARGEMENT PLAN

The Folsom Dam Enlargement Plan would increase the maximum flood pool elevation from 466 to a range between 478 and 487 feet. The corresponding increase in flood control storage space would range from 47,000 to 155,000 acre-feet, respectively (USACE 2000). The Reclamation

Board and SAFCA (non-Federal project sponsors) have a planning objective of at least a 200-year level of protection for Sacramento and the ability for Folsom Dam to pass the probable maximum flood without jeopardizing the dam.

Three enlargement alternatives were developed using a maximum flood pool elevation of 478, 482 and 487 feet. The probability of flooding in Sacramento from levee failure would be reduced from 1 chance in 164 in any one year (with moderate advance release), to 1 chance in 189 (flood pool elevation 478); 1 chance in 213 (flood pool elevation 482); or 1 chance in 233 (flood pool elevation 487) in any one year with moderate advanced release.

Several constraints were imposed by the Corps on plan formulation for Folsom Dam raising:

- dam raise measures are solely for flood control as stipulated in section 566 of WRDA 1999.
- dam raise measures are to avoid disruptions to the normal operation of Folsom Dam for water supply, hydropower, and flood control.
- no loss of flood protection from existing flood damage reduction projects is permitted.
- minimize disturbance of habitat for threatened and endangered species.
- compliance with numerous laws, Executive Orders, and policies must be considered.

The Folsom Dam Enlargement Plan would include components to increase flood storage space as follows[1]:

a. **3.5-foot raise with a 478-foot pool elevation**. This alternative would include several actions: (a) replacement of the eight existing spillway gates; (b) lowering of the spillway 6 feet and modification of the bridge piers to anchor the new gates; (c) replacement of the existing eight-span spillway bridge; (d) raising the concrete dam 3.5 feet with parapet walls; (e) raising embankment dams and dikes with a 3.5-foot-high concrete wall and extension of the existing slurry walls in Mormon Island Dam and Dikes 5 and 7; (f) construct a 7-foot-high parapet wall around the Newcastle Powerhouse; (g) construction of a temporary Folsom Dam operation and maintenance bridge (about ¼-mile in length); (h) modifying the existing elevator tower; (i) purchasing flowage easements from seven or eight landowners; (j) enlarging the L.L. Anderson Dam (French Meadows Reservoir) spillway so that the dam can safely pass the probable maximum flood; and (k) some additional structural work on Folsom Dam (such as replacement of the gantry crane, modification of the penstock wheel gates, hydraulic control units, etc).

Borrow areas for the embankment materials have been identified at the peninsula between the north and south forks of the American River at Folsom Lake. The peninsula material (10,000 cubic yards; 90 acres) will be barged across Folsom Lake, then trucked to the construction site. Staging areas have been selected immediately adjacent to the construction sites and located to minimize vegetation disturbance.

[1] For initial planning purposes, the construction footprint for direct impacts of raising the dam was identical in all raise options; operational impacts however, would vary in the enlarged reservoir area.

Additional lands or flood easements would need to be acquired at a few locations where the enlarged flood pool would extend beyond the Federal Project boundary and for mitigation of environmental impacts at the borrow sites and construction areas.

L.L. Anderson Dam is owned by the Placer County Water Agency and is located on the Middle Fork of the American River above Folsom Dam. The embankment dam has inadequate spillway capacity and would overtop and fail during a probable maximum flood event. This failure would add about 250,000 cubic feet per second to the probable maximum flood at Folsom Dam. Providing for passage of that additional flow at Folsom would be considerably more expensive than modifying L.L. Anderson Dam and spillway for safe passage of the probable maximum flood event.

The following modifications are proposed for L.L. Anderson Dam: (a) remove the existing two-tainter-gate ogee crest control structure and replace it with a new three-tainter-gate ogee crest control structure at the spillway entrance; (b) deepen (about 23 feet) and extend (about 100 feet) the existing rock excavated spillway channel, (c) widen two constriction points in the spillway escape channel; and (d) raise (to a maximum 3.6 feet high) and extend (about 1,400 feet) the existing parapet wall. The excavated material would be placed at an existing disposal area adjacent the spillway escape channel.

This alternative would increase the storage capacity by 47,000 acre-feet revise the dam reoperation variable flood control space to a total range of 447,00-647,000 acre-feet. Water releases made through the dam are made through the gated outlets at the lower level of the dam. Releases are restricted to the capacity of the discharge structures and by existing operation criteria that limits the increases in release rates. The lower level outlet capacity will be 115,000 cubic feet second (cfs) once the Folsom Dam Outlet Modification Project is complete. The reservoir begins to fill once inflow exceeds this outflow capacity. The outflow rate remains at 115,000 cfs until the water level reaches the spillway crest, at which time spillway releases from the main gates can begin. The maximum emergency release is 160,000 cfs with a maximum duration of 48 hours. The reservoir water surface elevation could raise from 474 to 478 at infrequent intervals, the expected duration of such events above 474 would be at most 1 day (USACE 2001)

b. **8.5-foot raise with a 482-foot pool elevation**. This plan is similar to the above plan except that: (a) the raise would be accomplished by raising the concrete monolith and embankments and adding a 3.5 foot parapet wall; (b) the spillway would not have to be lowered; (c) the floodwall constructed at the Newcastle Powerhouse would be about 12 feet high; (d) about a-mile of the Folsom Dam Road southeast of the left wing dam would be raised to avoid inundation; and (e) about 90 acres (75,000 cubic yards) of the Peninsula borrow site, and 140 acres (675,000 cubic yards) of the Mississippi Bar site would be used for construction material, and flowage easements would be purchased on 13-14 properties in the Mooney Ridge area of Granite Bay.

The top of flood pool elevation is limited to 482 feet as this is the maximum normal operation that meets dam stability criteria. This alternative would increase the reservoir storage capacity by 95,000 acre-feet and would revise the dam reoperation variable flood space to a total range of 495,000-695,000 acre-feet. The same operation limits as discussed for the 3.5-foot raise also apply to this alternative

c. **12-foot raise with a 487-foot pool elevation**. This plan is the same as the 8.5 foot raise plan above, plus: (a) new high-strength post-tensioned steel cables would be cored and grouted into the pier/dam section to provide for trunnion anchorage when replacing the spillway gates; (b) piers would be raised and extended downstream to anchor the new larger radial gates when modifying the spillway bridge piers; (c) the concrete dam would be raised 12 feet; (d) post-tensioned tendons would be used to anchor the dam's concrete mass to the bedrock; (e) the floodwall at the Newcastle Powerhouse would be about 16 feet high; (f) about 90 acres (150,000 cubic yards) of the Peninsula borrow site, and 140 acres (1,350,000 cubic yards) of the Mississippi Bar site would be used for construction material; and (g) one or two additional properties would have flowage easements purchased and one property would be purchased in fee title.

This alternative would increase the storage capacity by 157,000 acre-feet. It also represents the maximum feasible amount of dam raise possible before a higher level of extensive modifications of the structure would be required, including foundation work that would require dewatering the reservoir. The dam's reoperation variable flood space would have a total range of 557,000-757,000 acre-feet. The same operation limits as discussed for the 3.5-foot and 8.5-foot raises also apply to this alternative

IV. BIOLOGICAL RESOURCES

A. EXISTING CONDITIONS

Existing conditions are those conditions which exist in the project area at the time of the impact analysis.

1. FOLSOM DAM ENLARGEMENT

a. Vegetation.

Around Folsom Reservoir and Upstream

The area surrounding Folsom Reservoir supports a mix of habitat types, dominated by blue oak-gray pine woodland; gray pines are relatively scarce in most of this habitat, contributing perhaps 1% or less of canopy cover. The lower foothill area near Folsom Dam contains large areas of oak woodland, with scattered blue oaks and interior live oaks. Small areas of chaparral extend to the reservoir's upper edge particularly along the South Fork arm. Annual grassland areas are interspersed throughout the area, and human-disturbed habitats occur around boat-launch facilities. Relatively small areas of riparian habitats can found along tributaries to the reservoir and in seep areas. Willow stands and individual trees have become established within some areas of the reservoir pool (USFWS 1994).

Lower American River
The lower American River, although highly modified from conditions of 150 years ago, supports a diverse and highly valuable area for biological resources. The 23-mile long reach encompasses about 4,800 acres of floodplain, containing large areas of grasslands and pasture, riparian cottonwood and oak woodlands, herbaceous plants and riparian scrub-shrub, bare sand and gravel, and surface waters of the river and associated sloughs and dredge ponds. About 4,000 acres of undeveloped uplands abut the floodplain, providing upland habitats including oak woodland and grasslands (USFWS 1994).

b. Fish

In Folsom Reservoir and Upstream
Folsom Reservoir supports self-sustaining warmwater populations of largemouth and smallmouth bass, white catfish, channel catfish, and brown bullhead. Rainbow trout, a cold water fish, are planted regularly by the California Department of Fish and Game (CDFG). Sportfishing is an important and popular recreational activity at Folsom Reservoir. Fish populations can decline in drought years, when low water levels reduce the amount of habitat available for fish.

The fish populations of the North and South Forks are fairly similar, representing fishes characteristic of the lower Sierra Nevada foothills. The lower North Fork supports self-sustaining populations of warmwater fish including smallmouth bass and green sunfish, among gamefish, as well as Sacramento pike minnow and Sacramento sucker, sculpins, and brown bullheads. A few rainbow trout are present in the lower North Fork, but summer water temperatures are generally too warm for reproduction (USFWS 1991b).

Lower American River
The lower American River supports a diverse and abundant fish community; altogether, at least 41 species of fish are known to inhabit the river (USFWS 1986). In recognition of its "outstanding and remarkable" fishery resources, the entire lower American River was included in the Wild and Scenic Rivers System in 1981, which provides some protection for these resources (USFWS 1991a). Four anadromous species are important from a commercial and recreational perspective. The lower river supports a large run of fall-run chinook salmon, a species with both commercial and recreational values. The salmon run is sustained by natural reproduction in the river, and by hatchery production at the Nimbus Salmon and Steelhead Hatchery, operated by CDFG; fall-run chinook salmon raised at the Nimbus Hatchery provide roughly 40% of the salmon production of the American River (USFWS 1986). Roughly 40,000 fall-run chinook return to the river annually, on the average, of which about 20,000 spawn naturally in the river, with much of the remainder being caught by anglers or ascending a fish ladder to Nimbus Hatchery (CDFG 1994; F. Meyer, CDFG, pers. comm. *in* USFWS 1994).

Steelhead, a popular sports fish, are largely sustained in the river by production from the Nimbus Hatchery, because summer water temperatures often exceed the tolerances of juvenile steelhead, which typically spend about 1 year in the river. American shad and striped bass enter the river to spawn; these two species, introduced into the Sacramento River system in the late 1800s, now support popular sports fisheries. In addition to species of economic interest, the lower American River supports many nongame species, including Sacramento pike minnow, Sacramento sucker, tule perch, and hardhead (USFWS 1994).

c. <u>Wildlife</u>

<u>Around Folsom Reservoir and Upstream</u>

The area around Folsom Reservoir supports an animal community characteristic of the lower Sierra Nevada western slope. Although the range of elevation is small, habitats are diverse, in part because the reservoir extends about 20 miles into the Sierra Nevada foothills, from gentle hills near the dam to steep-walled canyons along the forks of the American River. More than 50 species of mammals live in these areas (USFWS 1986). Common species include mule deer, striped skunk, black-tailed jackrabbit, brush rabbit, raccoon, California ground squirrel, and a diverse assemblage of small mammals including mice, voles, and pocket gophers. Less common mammals include river otters, mountain lions, badgers and bobcats. Birds typical of oak-dominated habitats include acorn woodpeckers, scrub jays, ash-throated flycatchers, and California quail. Oaks provide acorns, a nutrient-rich and important food source for mule deer, acorn woodpecker, northern flicker, Nuttall's woodpecker, white-breasted nuthatch, and scrub jay. In addition to a diverse community of small passerine birds, other birds such as woodpeckers, California quail, introduced wild turkeys, Canada geese, and various birds of prey are fairly common near the reservoir.

The presence of year-round water provides habitat for many water-associated species such as raccoon, Canada geese, wood duck, common merganser, mallard , black phoebe, great blue heron, greater yellowlegs, belted kingfisher, and common yellowthroat.

Mammals typical of a mix of riparian habitat and woodland habitats with a grassy understory include California vole, ringtail, black-tailed jackrabbit, coyote, striped skunk, and mule deer.

Reptile and amphibian species likely found in the study area include western fence lizard, gopher snake, western rattlesnake, common kingsnake, Pacific treefrog, and western toad.

Wildlife species that forage or breed in oak woodlands also include dusky-footed woodrat, western bluebird, and southern alligator lizard.

Areas dominated by annual grassland provide foraging habitat and cover for California ground squirrel, pocket gopher, turkey vulture, coyote, western fence lizard, western rattlesnake, western kingbird, and western meadowlark. Grassland areas are important to many foraging raptors; red-tailed hawk, golden eagle, ferruginous hawk, rough-legged hawk, American kestrel, and prairie falcon all spend time in the area, as wintering and/or breeding birds.

Lower American River
The lower American River corridor provides a mosaic of riparian, riverine, grassland, and oak woodland habitat. These diverse habitats support a corresponding diversity of wildlife.

The lower American River provides feeding, resting, and/or nesting habitat for as many as 200 bird species (USFWS 1986), many of which require the aquatic areas of the river and backwaters, or the riparian vegetation of the ecosystem. Riparian areas are known to support a species-rich songbird community (Gaines 1977), and the lower American River also provides habitat for many raptors, including Swainson's hawks, red-shouldered hawks, Cooper's hawks, and great-horned owls, all of which require or are closely associated with riparian vegetation. Bald eagles, which are more common around Folsom Reservoir, occasionally use the lower river, which provides roosting and foraging habitat. Waterfowl, particularly mallards, also use the area extensively.

More than 50 species of mammals have been recorded for the area (USFWS 1986). Common species include beaver, black-tailed jackrabbit, striped skunk, Virginia opossum, raccoon, California ground squirrel, gophers, and many small rodents and insectivores including voles, moles, shrews, deer mice, and pocket gophers. Uncommon species include mule deer, and several carnivores, such as badger, long-tailed weasel, river otter, gray fox, coyote, bobcat, and mink.

Reptile species of the lower American include common kingsnake, Gilbert and western skinks, southern alligator lizard, western fence lizard, gopher snake, several garter snakes, and the northwestern pond turtle, which is a candidate for federal listing. Common amphibians include Pacific treefrog, California newt, California slender salamander, western toad, and the introduced bullfrog.

Relatively little is known about invertebrates of the lower American River, but elderberry plants are fairly common in areas, and provide habitat for the endangered valley elderberry longhorn beetle.

2. FRENCH MEADOWS RESERVOIR

a. Vegetation

Around French Meadows Reservoir
The area around French Meadows Reservoir consists of a mixture of two habitat types:
(a) Sierran mixed-conifer forest, and (b) montane riparian scrub (PG&E 1997). The spillway channel is flanked by stands of mixed conifer forest. Dominant tree species include: red fir, douglas fir, ponderosa pine, incense cedar, sugar pine and white fir. Shrubs include red-flowering current, bitter cherry, western choke-cherry, and snowberry (PG&E 1997).

Riparian scrub occurs along portions of the margins of the scoured channel where disturbance has been minimal. Much of the channel has been constructed in bedrock material which has little or no vegetation. Typical riparian species include narrow-leafed willow, red willow, shining willow, and Scouler's willow, mountain and thin leaf alder, black cottonwood, American dogwood, mountain spiraea, and bitter and western choke-cherry (PG&E 1997).

Some of the forbs and graminoids present include Indian paintbrush, fireweed, rush, monkeyflower, mint, beardtongue, and skullcap (JSA 2001a).

Middle Fork American River

The vegetation along the Middle Fork of the American River in the vicinity of the dam is similar to that described above. Riparian habitat predominately occurs in undisturbed areas and on gentle slopes.

b. Fish

French Meadows Reservoir

Resident fishes found in French Meadows reservoir include rainbow trout, brown trout, and brook trout, Sacramento sucker, speckled dace and other cold water species (JSA 2001a).

Middle Fork American River

The assemblage of fish species in the upper reaches of the Middle Fork American River are similar to that found in French Meadows Reservoir. In the lower reaches (near the confluence with the North Fork American River), warmwater species such as smallmouth bass occur.

c. Wildlife

French Meadows Reservoir

The Sierran mixed conifer habitat in the vicinity of the reservoir supports a variety of mammal, avian, and amphibian species. Typical mammals include deer, bear, and a wide variety of small mammal species. Typical bird species include osprey, Cooper's hawk, sharp-shinned hawk, northern goshawk, swallows, owls, woodpeckers, and numerous songbird species. Amphibian species could include northwestern pond turtle and foothill yellow-legged frog.

Middle Fork American River

The wildlife species along the Middle Fork American River would be similar to those around the reservoir.

B. FUTURE CONDITIONS WITHOUT THE PROJECT

Future without-project conditions are those conditions expected to occur over the life of the project if the project were not implemented.

1.   FOLSOM DAM ENLARGEMENT

a. Vegetation

Around Folsom Reservoir and Upstream

Without-project conditions for this project area are not expected to change significantly from the baseline condition over the life of the project. Refer to the baseline condition described under the no action alternative.

Lower American River
Under without-project conditions, vegetation in and along the lower American River would continue to undergo changes typically associated with a riparian system, but constrained and limited by the adjacent levee system, upstream dams, and regulated flow releases. Regeneration of riparian species, particularly cottonwood and willows, will slowly decline, as continued lateral erosion, net downstream sediment movement, and increased amount of higher terrace areas, exposed to less frequent flooding, develop as a result of increased channel stability. These processes have resulted from the construction of Folsom Dam and channel modifications along the lower American River (USFWS 1991a).

Sediment deposition needed for the establishment of these riparian species will continue to be limited by upstream impoundments. Forest complexes would be dominated by species adapted to relatively low water needs. Riparian species will gradually mature then die out, giving way to more drought-tolerant plant species such as ash, box elder, and valley and live oaks. Vegetation will continue to be affected by its location in a major metropolitan area. Associated impacts include vandalism, burning, and mowing for firebreaks, among the more common human disturbances. Some younger riparian vegetation that exists under baseline conditions will continue to develop over time into mature riparian woodland habitat. Habitat abundance and diversity is not expected to change significantly over time in the hydraulic mitigation areas.

b. Fish
Around Folsom Reservoir and Upstream
Without-project conditions for this project area are not expected to change significantly from the baseline condition over the life of the project. Refer to the baseline condition described under the no action alternative.

Lower American River
Conditions for fish in the lower American River are likely to change in the future without the project. However, the way in which it will change is difficult to predict. With implementation of the Anadromous Fish Restoration Program (AFRP) of the Central Valley Project Improvement Act (USFWS 1995), conditions in the lower American River would improve for fishery resources.

Other variables will determine the way in which flows are managed on the lower American River; including Bay-Delta water quality standards, Bureau of Reclamation water contract renewals, and new contracts.

Overall, under existing conditions, spawning gravel for salmonid species will eventually become more scarce within the river. As a result of gravel mining and construction of Folsom and Natomas Dams, gravel replenishment sources are limited. Although spawning gravel quantity does not currently appear to be a limiting factor for salmonid spawning (Bill Snider, pers. comm. 1996 *in* USFWS 1996) we would expect losses of spawning sediments as time passes. Continued sediment losses would eventually degrade spawning habitat. This degradation could be reversed under restoration measures being considered under the CVPIA, which provide for restoration of lost spawning gravels (USFWS 1995).

c. Wildlife

<u>Around Folsom Reservoir and Upstream</u>

Without-project conditions for this project area are not expected to change significantly from the baseline condition over the life of the project. Refer to the baseline condition described under the no action alternative.

<u>Lower American River</u>

The types of wildlife species found in the area will likely change somewhat along the lower American River under without project conditions, due primarily to the changes in vegetation described above and overall habitat abundance and diversity. Species which would decrease in number are those that prefer tree species such as cottonwood and willow for perching, foraging, and/or nesting (USFWS 1991c), as these plant species would likely decrease over time. Such wildlife species include birds such as woodpeckers, flickers, wrens, and raptors, and other avian species that use these riparian areas to meet their life requirements. Alternatively, species that prefer more arid habitats, such as oak woodland, would increase over time.

2. FRENCH MEADOWS RESERVOIR

Without-project conditions for vegetation, fish, and wildlife in the project area are not expected to change significantly over the life of the project. Since it has been determined that the existing dam cannot pass the probable maximum flood, it is assumed that this deficiency would be required to be corrected in the future; however, there is currently no schedule to complete this activity without the project.

C. FUTURE CONDITIONS WITH THE PROJECT

Future with-project conditions are those conditions expected to occur over the life of the project if the project were implemented.

1. FOLSOM DAM ENLARGEMENT

a. <u>Construction Impacts</u>

<u>Folsom Reservoir</u>

a. Vegetation

Construction of the any of the three alternatives would impact a total of 266.7 acres, which includes the footprint of the new facilities and the construction easement area. Four of the cover-types impacted, oak woodland, blue-oak woodland, riparian, and seasonal wetland, were considered permanent impacts which would need compensatory mitigation. The compensation acreage is summarized for these cover-types in Table 1. The HEP used to develop the compensatory mitigation acreage is included in Appendix A.

Table 1. Summary of Cover-Types, Acres Impacted, and Compensation Need for the construction of the Folsom Dam Enlargement Alternatives of the American River Watershed Investigation, Long-Term Evaluation, California.

Folsom Dam and auxiliary dam and dikes raised 3.5, 8.5, or 12 feet (pool elevations 478, 482, 487 msl).		
Cover-Type	Acres Impacted	Compensation Need
Blue oak - gray pine woodland	3.8	10.50
Oak woodland	21.4	59.41
Riparian woodland	9.0	9.00
Seasonal wetland	0.3	0.30
Annual grassland	80.0	Re-plant
Other	152.2	N/A
TOTAL	266.7	79.21

Impacts to annual grassland would be minimized by seeding all disturbed areas as soon as construction activities are complete in the disturbed area. It was anticipated that the work would be phased, so the entire annual grassland area would probably not be disturbed at the same time. Similarly, the impacts to the lands identified as "other" can be minimized by replanting with annual grasses, when possible (these areas are roads, parking lots, riprap, etc, that do not currently provide significant values for fish and wildlife species).

b. Fish

Given the constraint placed on project development that dam measures are to avoid disruptions to the normal operation of Folsom Dam for water supply, hydropower, and flood control (USACE 2000), no impact to the existing fishery of Folsom Reservoir is anticipated. This determination will continue to be reviewed as the project is more fully developed.

c. Wildlife

About 34.5 acres of existing habitat for wildlife species (does not include the "other" or annual grassland cover-types in Table 1) would be lost with construction of the project. The compensatory mitigation, a total of 79.2 acres, is intended to offset this loss of habitat value over the life of the project.

<u>Lower American River</u>

a. Vegetation

No change in the existing conditions for vegetation in the Lower American River is anticipated, because the construction impacts of any Folsom Dam raise plan to create additional flood control would impact only storage space in the reservoir.

b. Fish

Given the constraint placed on project development that dam measures are to avoid disruptions to the normal operation of Folsom Dam for water supply, hydropower, and flood control (USACE

2000), no impact to the existing fishery of Folsom Reservoir is anticipated. This determination will continue to be reviewed as the project is more fully developed.

c. Wildlife

No change in wildlife species numbers or species composition is expected to occur along the Lower American River as a result of enlarging Folsom Dam.

Newcastle Powerhouse

A floodwall either, 7-, 12-, or 16-feet high, would be constructed around the powerhouse depending on the dam raise alternative selected. All of the work (staging, construction easements, etc.) would be confined to the existing parking lot and roads at the powerhouse. There should be no impact to fish and wildlife resources if this plan does not change. At this time no road improvements for access to the powerhouse are planned.

Folsom Dam Operation and Maintenance Road and Bridge

The Corps provided an enlarged aerial photograph of the currently proposed footprint and construction easement of a temporary operation and maintenance road and bridge on March 26, 2001. The HEP Team and Reclamation subsequently conducted a site review and cover-typed the area on the photograph. Since this alignment is considered preliminary and intersected numerous patches of oak woodland and riparian cover-types, the review team decided to request the Corps to consider minor realignment to the road to avoid this vegetation. The cover-types impacted and compensation needed with the revised alignment are summarized in Table 2.

Table 2. Summary of Cover-Types, Acres Impacted, and Compensation Need for the construction of a temporary Folsom Dam Operation and Maintenance Road and Bridge the American River Watershed Investigation, Long-Term Evaluation, California.

Folsom Dam Operation and Maintenance Road and Bridge		
Cover-Type	Acres Impacted	Compensation Need
Oak woodland	1.70	4.72
Riparian woodland	1.30	1.30
Blue oak/gray pine woodland	2.90	8.01
Annual grassland	0.50	Re-plant
Other	4.60	N/A
TOTAL	6.40	14.03

b. Operational Impacts

Folsom Reservoir

a. Vegetation

Between 778 and 1,305 acres would be affected by enlarging Folsom Dam, depending on which dam raise alternative is selected. Some of these lands are already developed or otherwise disturbed habitat which provide little or no value for wildlife species, and some support vegetation that is tolerant of flooding. Table 3 summarizes the acreage of each habitat which provides value for wildlife that is expected to receive inundation over the life of the project (the "Other" cover-type is not included in Table 3). Inundation effects around Folsom Reservoir would occur in large part by the frequency, timing, and duration of flooding.

Table 3. Summary of cover-types and their acreage which would be inundated at Folsom Reservoir at full flood pool if Folsom Dam were raised 3.5, 8.5, or 12 feet as part of the American River Watershed Investigation, California.

PROJECT FEATURE	COVER-TYPE	ACREAGE		
		3.5-foot raise 478 Pool	8.5-foot raise 482 Pool	12-foot raise 487 Pool
Folsom Reservoir (operations)	Blue oak - gray pine	283.7	367.3	469.7
	Oak woodland	205.2	264.2	350.0
	Riparian woodland	20.9	24.5	30.8
	Chaparral	20.1	28.7	38.7
	Seasonal wetlands	2.6	2.6	2.9
	Annual grassland	80.5	106.5	172.7
	SUBTOTAL	612.3	793.8	1,064.8

Studies to date indicate that predicting the effects of inundation on vegetation is not straightforward. The raising of Folsom Dam would have the potential for two significant impacts on vegetation: (1) changes in vegetation composition caused by inundation affecting survival and reproduction of vegetation in the zone between current and proposed maximum reservoir levels; and (2) effects of inundation on soil erosion and slippage, especially on steep slopes as are found along the upper reservoir and the forks of the American River.

The vegetation types exposed to flooding are not, in general, highly tolerant of prolonged flooding. With the exception of riparian and riverine habitats, natural flooding does not occur in the areas which would be flooded by raising Folsom Dam. Studies of the effects of inundation on blue oaks (Harris et al. 1969, 1975 *in* USFWS 1980; MWA-JSA 1994) have found that blue oaks can survive some flooding, but may be sensitive to periods of inundation of as little as 7 days. It is not clear from these studies, however, at what time of year flooding occurred, and the ability of vegetation to tolerate inundation depends on the time of year. For example, deciduous trees, such as oaks, tend to be much more sensitive to flooding during their period of active growth (i.e., in the spring), while winter-dormant plants appear to be more tolerant of flooding (USFWS 1980). Folsom Reservoir can be expected to fill during spring flood event, when oaks are actively growing. The absence of blue oaks within the inundation zone of Folsom Reservoir and other foothill impoundments indicates that blue oaks cannot tolerate the flooding regime existing there. Further, evergreen species, including gray pines and live oaks, occur commonly around the reservoir, and tend to be more sensitive to inundation than deciduous trees such as blue oaks (MWA-JSA 1994).

The Corps has developed preliminary data (most recent version is dated March 9, 2001) on water surface elevation and computed probability and duration (hours or days) for 10 alternative floods ranging from a 50 to the 500-year event. This information (days and hours version) is found in the HEP report (Appendix A, Tables 6 and 7). A worst case scenario for vegetation in the new storage area is a reservoir at maximum flood pool (487 elevation) for 1 day (13 hours) and 3 days (65 hours) at an elevation just above existing conditions during a 500-year flood event. This is 13 and 39 hours above the baseline condition, respectively. During a 200-year event, water would not reach elevation 487 and the lower zone would again be inundated for a maximum of 3 days (66 hours), or 46 hours over the baseline condition.

The other factor which could affect vegetation is erosion (slippage) of the saturated soil in the new inundation area during a flood event as the water is drawn down or from wind driven wave wash during a major storm event. Slopes in the Folsom Reservoir area are generally between 5 and 25% (USACE 2001). Slopes in the Mooney Ridge area in the northwestern corner of the reservoir and the shoreline just west of the South Fork of the American River exceed 30% (USACE 2001). It is likely that during a major flood event some, or all, of the soil on steep slopes would experience some erosion. The extent of erosion and its effect on vegetation would be difficult to predict.

The cover-types and their acreage which would likely be adversely affected over the life of the project is summarized in Table 4. Annual grassland is included due to the potential effects of erosion.

Table 4. Summary of cover-types and their acreage which would be inundated at Folsom Reservoir at full flood pool if Folsom Dam were raised 3.5, 8.5, or 12-feet as part of the American River Watershed Investigation, California.

PROJECT FEATURE	COVER-TYPE	ACREAGE		
		3.5-foot raise 478 Pool	8.5-foot raise 482 Pool	12-foot raise 487 Pool
Folsom Reservoir (operations)	Blue oak - gray pine	283.7 (784)	367.3 (1,015)	469.7 (1,298)
	Oak woodland	205.2 (570)	264.2 (733)	350.0 (927)
	Chaparral	20.1 (20)[1]	28.7 (29)	38.7 (39)
	Annual grassland	80.5 replant	106.5 replant	172.7 replant
	SUBTOTAL	589.5 (1,374)	766.7 (1,777)	1,031.1 (2,264)

1. This assumes a 1:1 replacement ratio as the HEP for this cover-type was not completed.

Assuming a worst case scenario that over the life of the project all of the existing vegetation in the inundation zone would be lost, a compensation need was developed for each cover-type using the HEP results. These numbers (rounded to whole acre) appear in parentheses next to the acreage impacted in Table 4. Statistically, there is a relatively small chance of complete inundation coupled with total loss of vegetation. However, it is reasonable to expect some impacts, especially at the lower zones due to the potential for more frequent inundation, over the life of the project.

Given the uncertainties on effects of inundation on vegetation and soil erosion, the HEP Team decided to recommend that a monitoring and adaptive management program be developed to monitor vegetation around the reservoir over the life of the project. Baseline conditions would be managed and updated at 10-year, or some other predetermined interval. After major flood events (those which encroach above the existing maximum flood pool elevation), vegetation would be surveyed and damages attributable to inundation would be mitigated as deemed appropriate using best management practices at the time (replanting on site would be the first priority).

Lastly, preliminary work conducted by the Corps indicates that one or more bridges or culvert crossings and/or their approaches may be inundated for short periods of time along Salmon Falls Road to accommodate the maximum flood pool with the 12-foot dam raise (pool elevation 487). No impacts to fish and wildlife resources were identified for this potential short duration flooding.

b. Fish

No operational effects for reservoir fish species are anticipated.

c. Wildlife

No operational effects for wildlife species are anticipated, provided there is no accelerated erosion associated with the new inundation zone.

Lower American River

The raise plans would be identical to the without-project condition up to inflows of around 300,000 cfs, or about the 140-year event. Between the 140-year event (0.7% probability of occurrence) and about the 200-year event (0.5% probability of occurrence), the raise plan would maintain outflows at no more than 115,000 cfs, while the without-project conditions would be uncontrolled, resulting in very high outflows of 180,000-315,000 cfs. The pre-release option would improve flood protection to the 250-year event if in combination with the 8.5 or 12 foot raises, but has no effect on outflows at the 200-year or more frequent events. The duration of outflows does not appear to be significantly different between raise alternatives.

In reviewing the preliminary flow-frequency plots (Appendix D, provided for pre-release only), we noted that the 115,000 cfs objective flow was not attained until about the 25-year event, much less frequent than shown in the plots provided for previous analysis of the outlet/surcharge modification project (Appendix E). If not an error and related to pre-release, it suggests that outflows could be reduced by up to 25,000 cfs at the 10-year event (to 90,000 cfs), refer to Table 5..

Table 5. Discharge peak and duration of at least 115,000 cfs as a function of event size for dam raising alternatives for the American River Watershed Investigation, Long Term Evaluation project (estimated from interpretation of Corps of Engineers flood routings). For pre-release assumptions, see text. Parenthetical discharges would exceed the probable non-failure point of the channel levees.

raise to:/ event size (feet msl/ years)	maximum baseline discharge, 1000 cfs, no-pre/pre-release	No Pre-release						Pre-release					
		Hours at 115,000 cfs or more			Maximum discharge, 1000 cfs			Hours at 115,000 cfs or more			Maximum discharge, cfs		
		478	482	487	478	482	487	478	482	487	478	482	487
20	115	55	50	50	115			not provided					
50	115	80	80	80	115			110			115		
100	115	160+			115			160+			115		
150	150/(200)	170+			120	115	115	170+			115		
200	(280)/(180)	170+			(205)	155	130	170+			(180)	145	120
250	(375)/(180)	170+			(315)	(243)	(190)	170+			(240)	160	145

a. Vegetation

Folsom Dam would be raised 3.5, 8.5, or 12 feet with the project, and the additional space used to detain flood flows while outflows remain to the extent possible within the 115,000 cfs objective capacity of the downstream channel. This detention would reduce peak flows, while increasing the duration of flows, relative to existing conditions. The moderated flows may reduce erosive energy compared to existing conditions, and could have a cumulative or indirect effect on carryover storage.

b. Fish

No long-term operational effects for fish species are anticipated.

c. Wildlife

No long-term operational effects for wildlife species are anticipated.

2 FRENCH MEADOWS

<u>Construction Impacts</u>

<u>French Meadows Reservoir</u>

a. Vegetation

The total area to be excavated is about 1.4 acres. About 0.24 acre of this are Sierran mixed conifer forest and a few widely scattered willow species. The remainder of the area is rock material. The knob excavation would require access across the Middle Fork American River which would be accomplished using the same road alignment and crossing that was utilized in spillway work completed in 1998. No vegetation is present on this alignment. Impacts would be minimized by reseeding disturbed soil areas with annual grass species.

b. Fish

Potential adverse effects from construction of the project on fish species are related to reduced water quality, alteration of physical habitat, and impeding fish passage during construction. These impacts can be minimized by developing an erosion control plan, work windows, and an on-site fishery management plan should fish salvage be necessary.

c. Wildlife

No direct impacts to wildlife species are expected to occur, provided measures are implemented to prevent swallows from nesting on the French Meadows spillway bridge crossing, and raptor nesting is not disturbed by blasting and truck activity.

Operational Impacts

French Meadows Reservoir

No operational impacts are expected for vegetation, fish, or wildlife at French Meadows Reservoir with the project.

Middle Fork American River

No operational impacts are expected for vegetation, fish, or wildlife in or along the Middle Fork American River with the project.

D. THREATENED AND ENDANGERED SPECIES

Appendix B provides a list of the federally listed species for the Folsom Dam Enlargement and French Meadows Reservoir areas (Sacramento, Placer, and El Dorado Counties), dated July 31, 2001, and a summary of a Federal agency's responsibilities under section 7(a) and (c) of the Endangered Species Act (Act) of 1973, as amended. Appendix B also provides a list of State listed species. The Corps should request in writing from the Service a list of all federally listed and proposed threatened and endangered species within the project area, or an update of any list more than 90 days old at the time preparation of any additional or updated Biological Assessment for this project is undertaken. The National Marine Fisheries Service (NMFS) has responsibility for federally listed marine fish and wildlife species, including all anadromous salmonids. They should be contacted if any of these species may be impacted by project activities. The California Department of Fish and Game (Department) has responsibility for State listed species and species of concern. Species accounts for most of the species discussed below may be obtained from the Sacramento Fish and Wildlife Office.

There are 12 federally listed threatened species which may occur in the project area. These are: bald eagle, giant garter snake, California red-legged frog, delta smelt and its critical habitat, Lahontan cutthroat trout, Central Valley steelhead, Central Valley spring-run chinook salmon and its critical habitat, winter-run chinook salmon and its critical habitat, Sacramento splittail, valley elderberry longhorn beetle and its critical habitat, Layne's butterweed, and delta green ground beetle.

There are 12 federally listed endangered species which may occur in the project area. These are: vernal pool tadpole shrimp, vernal pool fairy shrimp, Conservancy fairy shrimp, Stebbin's morning glory, Pine Hill ceanothus, Pine Hill flannelbush, El Dorado bedstraw, Truckee barberry, riparian (San Joaquin Valley) woodrat, Antioch Dune evening-primrose, Sacramento Orcutt grass, and slender Orcutt grass.

In addition, there is one proposed threatened species (mountain plover), three candidate species for listing (California tiger salamander, Tahoe yellow-cress, and Central Valley fall/late fall-run chinook salmon), and numerous species of concern. See Appendix B for a listing of these latter species and a current State listed species.

V. DISCUSSION

A. MITIGATION PLANNING GOALS

The recommendations provided herein for mitigation and the protection of fish and wildlife are in conformance with the Fish and Wildlife Service's Mitigation Policy as published in the Federal Register (46:15; January 23, 1981). The Mitigation Policy provides Service personnel with guidance in making recommendations to protect, conserve, and enhance fish and wildlife and their habitats. The policy helps ensure consistent and effective Service recommendations, while allowing agencies and developers to anticipate Service recommendations and plan early for mitigation needs. The intent of the policy is to ensure protection and conservation of important and valuable fish and wildlife resources.

Under the Mitigation Policy, resources are assigned to one of four distinct Resource Categories, each having a mitigation planning goal which is consistent with the fish and wildlife habitat values involved. The Resource Categories cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be much more common and of relatively lesser value to fish and wildlife. In applying the Mitigation Policy during an impact assessment, each specific habitat or cover-type that may be impacted by the project is identified. Evaluation species which utilize each habitat or cover-type are then selected for Resource Category determination. Selection of evaluation species can be based on several rationales, including: (1) species known to be sensitive to specific land and water use actions, (2) species that play a key role in nutrient cycling or energy flow, (3) species that utilize a common environmental resource, or (4) species that are associated with important resource problems, such as anadromous fish and migratory birds, as designated by the Director or Regional Directors of the Service. Evaluation species used for Resource Category determinations may or may not be the same evaluation elements used in an application of Habitat Evaluation Procedures (HEP). Finally, based on the relative importance of each specific habitat to its selected evaluation species, and the habitat's relative abundance, the appropriate Resource Category and associated mitigation planning goal are determined.

Mitigation goals are: (1) no loss of existing habitat value (Resource Category 1); no net loss of in-kind habitat value (Resource Category 2); no net loss of habitat value while minimizing loss of in-kind habitat value (Resource Category 3); and minimize loss of habitat value (Resource Category 4). As defined in the Service's Mitigation Policy, "in-kind replacement" means providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate those lost.

Under Pacific Region Service guidance, we are also pursuing a goal of no net loss of wetland acreage, while seeking a net overall gain in the quality and quantity of wetlands through restoration, development and enhancement. Furthermore, the Service believes that wetlands compensation, which is the creation of wetlands to offset losses, should only be deemed acceptable when losses are determined to be unavoidable and compensation is known or believed to be technically feasible. Restoration of former or degraded wetlands is the preferred form of compensatory mitigation, followed by wetlands creation.

In recommending mitigation for adverse impacts to any of these habitats, the Service uses the same sequential mitigation steps recommended in the Council on Environmental Quality's regulations. These mitigation steps (in order of preference) are: avoidance, minimization, rectification, reduction or elimination of impacts over time, and compensation.

1. FOLSOM DAM ENLARGEMENT PLAN - FOLSOM RESERVOIR AREA

Impacts to nine habitat types were evaluated for the Folsom Dam Enlargement Plan. These habitats, and their corresponding evaluation species, designated Resource Categories and associated mitigation planning goals are discussed below, and summarized in Table 6.

a. <u>Blue oak-gray pine woodland</u>

Blue oak-gray pine woodland is usually dominated by a blue oak overstory, with gray pines interspersed at low density among the oaks. Other trees associated with this habitat type are California buckeye, which occurs as scattered individuals or small clumps, and interior live oak. On more mesic sites, such as north-facing slopes along the South Fork near Salmon Falls, live oaks and California black oaks replace blue oaks as the dominant oak. Understory shrubs such as manzanita, toyon, and shrubby oaks are often present, though typically at low densities, relative to tree cover.

The canopy of blue oaks is typically 30 to 50 feet tall, and varies from about 30 to 80% canopy closure (Barbour 1988), with open areas containing shrubs and grasses. The understory is primarily annual grasses and forbs. Most existing stands of this type are in mature stages, with oaks to heights of up to 50 feet. Mature gray pines typically rise above the oaks, to heights of up to 75 to 100 feet. The long-term survival of this habitat type has been an issue of concern, because oak regeneration has been minimal for over 100 years (Holland 1976). Many factors have been implicated as causes for low recruitment of oaks, including browsing of seedlings, consumption of acorn crops by livestock and native wildlife, changes in fire dynamics, and possibly climatic changes and competition with introduced annual grasses (Barbour 1988; Verner 1988). Blue oak woodland provides high-quality wildlife habitat for a rich assemblage of species. In the western Sierra Nevada, 29 species of amphibians and reptiles, 79 species of birds,

Table 6. Evaluation Species, Resource Categories, and Mitigation Planning Goals selected for cover-types impacted by the Folsom Dam Enlargement Plan of the American River Watershed Investigation, Long-Term Evaluation, California.

COVER-TYPES FOR EACH COMPONENT OF THE PROJECT	EVALUATION SPECIES	RESOURCE CATEGORY	MITIGATION PLANNING GOALS
FOLSOM RESERVOIR			
Blue oak - gray pine woodland	breeding birds	2	No net loss of in-kind habitat value
Oak woodland	woodpecker guild, oak insect communities	2	No net loss of in-kind habitat value
Riparian woodland	belted kingfisher, raptor guild	2	No net loss of in-kind habitat value
Chaparral	breeding birds	3	No net loss of habitat value while minimizing loss of in-kind habitat value
Seasonal wetlands	marsh wren, red-winged blackbird, great blue heron	2	No net loss of in-kind habitat value
Annual grasslands	raptor guild, ground-foraging birds	4	Minimize loss of habitat value
Other[1]	none	4	Minimize loss of habitat value
FRENCH MEADOWS RESERVOIR			
Sierran mixed conifer forest		4	Minimize loss of habitat value
Montane riparian scrub		4	Minimize loss of habitat value

[1]No evaluation species were chosen because use by wildlife is minimal to none.

and 22 species of mammals find mature stages of this habitat suitable or optimum for breeding, where other, special habitat requirements are met (Verner and Boss 1980).

The evaluation species selected for Resource Category determination are breeding birds. These species were selected because: (1) their ecological roles (prey, predator, scavenger, etc.); (2) the Service has responsibilities to protect and manage many of these species under the Migratory Bird Treaty Act; (3) their high nonconsumptive value for birdwatching; and (4) this habitat provides required nesting, foraging, and cover habitat for many breeding bird species. Blue oak-gray pine woodland habitat is still relatively common in the project area and region, but is increasingly being degraded in value and in general not exhibiting regeneration (blue oaks). Therefore, the Service has placed this habitat in Resource Category 2 with its mitigation planning goal of no net loss of in-kind habitat value.

b. <u>Oak woodland</u>

Oak woodland (including oak savanna) occurs widely in the project area, particularly along the lower American River, and at lower foothill elevations, near Folsom Dam. Typical oak woodland is characterized by a fairly open canopy layer with 20-70% cover of blue and live oaks, and a grassy ground cover. A woody understory may be present, but is typically sparse where present. As described for blue oak-gray pine habitat, there has been poor recruitment into the oak population for the past century, threatening the future persistence of oak habitats. As discussed for blue oak-gray pine habitat, oaks provide breeding sites, shelter, and feeding opportunities for a diversity of wildlife species. For example, an average of 24 bird species nested in study plots of valley oak woodlands along the lower American River (Gaines 1977), and 30 bird species known to use California oak habitats include acorns in their diet (Verner 1980 *in* Ritter 1988).

Non-native annual grasses form an understory in most of the study area, and the transition from woodland to savanna is not clearly demarcated, but rather part of a continuum from closed canopy woodland to open, treeless grasslands. As a result, habitat types can grade imperceptibly from one to another. Where trees are absent, the habitat is designated as annual grassland. Because scattered oaks provide food, cover and nesting habitat unavailable in grasslands, we treated oak savanna as a component of oak woodland.

The evaluation species selected for oak woodland that could be impacted within the project area are the woodpecker guild, including acorn woodpecker, northern flicker, Nuttall's woodpecker , Lewis's woodpecker, and the oak insect community. Oaks are important to woodpeckers as nest and foraging sites, and woodpeckers excavate nest holes in live and dead trees and provide nest sites for other cavity-nesting species including ash-throated flycatcher, plain titmouse, and white-breasted nuthatch. Isolated savanna oaks also provide scarce shade and shelter to many other species. Several species are closely linked to oak forest, including acorn woodpeckers and western gray squirrel, and acorns are a nutrient-rich food used by many wildlife species. Oaks also support a rich and complex insect community, including leaf-miners (Opler 1974), and many species of gall-forming insects, which in turn are host to many parasitic insects. Oak insect communities have been the subject of many important studies of ecological community structure and dynamics. Because of the high value of oak woodland to the evaluation species, and because native oaks are a scarce and dwindling habitat in the Sacramento Valley, the Service finds that oak woodland affected by the project should have a mitigation planning goal of "no net loss of in-kind habitat value" (i.e., Resource Category 2).

c. <u>Riparian woodland</u>

Riparian woodlands occur extensively along the lower American River, and in patches along perennial and intermittent streams and rivers flowing into Folsom Reservoir. Two forms of riparian habitat occur in the study area: riparian forest, dominated by large trees, and riparian scrub-shrub, consisting mostly of low shrubs. Scrub-shrub habitat occurs in more frequently disturbed areas (e.g., by flood-scouring or human activities), and as a stage in regeneration of riparian forest following disturbance. The two forms are often interspersed (e.g., a clump of cottonwoods in an area of shrub-scrub), and are treated together in this report, as the existing data is inadequate to separate them. Trees characteristic of this habitat in the study area include cottonwoods, arborescent willows, and oaks; understory plants include wild grape, blackberries, poison oak, willows, and elderberry. Scrub-shrub habitat is frequently dominated by willows, and often contains other shrubby riparian species and immature trees listed above. Small areas of emergent wetlands, characterized by cattails, occur along the lower American River, and may reasonably be expected to occur in riparian areas upstream of Folsom Dam.

Riparian forests were formerly widespread in the region, but have been severely reduced by agricultural development, flood control measures (including channel modifications and vegetation removal), and decreased stream flows resulting from diversions and dams upstream. The riparian forest along the lower American River today is one of the larger and better-protected remnants of this habitat, and has been recognized as a "natural area of special significance" in the county general plan (County of Sacramento 1993).

Riparian vegetation provides feeding, nesting, and shelter habitat for many species which use the riparian zone and surrounding lands. Vegetation which overhangs or protrudes into the water also provides fish with cover, rearing, and food resources. Riparian habitat supports a species-rich assemblage of breeding birds, and provides food and cover for migratory birds. Because of its linear distribution and the extensive edge which that provides, the value of riparian areas to wildlife typically far exceeds the value of an equally-sized block of non-riparian woody habitat. Belted kingfishers, and raptors (including red-shouldered hawk, osprey, and American kestrel) were chosen to evaluate riparian habitat because: (1) as predators, they play a key role in community ecology of the study area; (2) they have important human nonconsumptive benefits (e.g., birdwatching); and (3) the Service has responsibility for protection and management of many of these species under the Migratory Bird Treaty Act. Riparian habitat is of generally high value to the evaluation species, and is today very scarce in the project area and general ecoregion. Therefore, the Service finds that any riparian habitats that would be impacted by the project should have a mitigation goal of "no net loss of in-kind habitat value or acreage"--i.e., Resource Category 2.

d. <u>Chaparral</u>

Chaparral occurs in patches along the south arm of Folsom Reservoir, and along the North and South Forks. Chaparral has a dense overstory of woody evergreen shrubs, and usually is found on drier sites, e.g., on southwest-facing slopes, and on shallow soils. Chaparral in the study area is often dominated by chamise, with manzanita, ceanothus, toyon, and shrubby oaks. Understory growth tends to be sparse, and is mostly annual grasses with a few forbs. Chaparral plants are notable for their high tolerance to drought, ability of seeds and/or plants to survive fire, and their high value as watershed cover (USFWS 1991a). Chaparral provides food resources, shelter, and breeding sites to many wildlife species; for example, chaparral on the western slope of the Sierra Nevada provides suitable or optimal nesting or breeding habitat for about 90 avian species, 10 amphibians, 18 reptiles and 41 mammals (Verner and Boss 1980).

Breeding birds were chosen to evaluate chaparral habitat because: (1) they play multiple roles in chaparral ecology, as predators, prey, and as seed dispersal agents; (2) they provide nonconsumptive recreational and other values to humans (e.g., birdwatching, bird song); and (3) the Service is responsible for protection and management of many of these species under the Migratory Bird Treaty Act. Chaparral habitat is a native habitat of generally high value to the evaluation species, and is today moderately scarce in the project area, but fairly abundant in the ecoregion. Therefore, the Service finds that any chaparral habitats that would be impacted by the project should have a mitigation planning goal of "no net loss of habitat value while minimizing loss of in-kind habitat value"--i.e., Resource Category 3.

e. <u>Seasonal wetlands</u>

Seasonal wetlands occur in small patches near seeps and springs, and in drainages entering Folsom Reservoir. Seasonal wetlands in the project vicinity are characterized by non-woody emergent vegetation, including cattails, rushes, and sedges. Two marsh-nesting passerine birds, the marsh wren and red-winged blackbird, as well as great blue heron were chosen to evaluate emergent wetland. The marsh wren and red-winged blackbird are passerine species which nest and feed in emergent wetlands, and could therefore be present in any occurrences of this cover type which may be found in the project area. Great blue herons forage extensively in wetlands on aquatic vertebrates; these herons are a highly visible species, which many people take great pleasure in observing. All of the evaluation species are also migratory birds for which the Service has management responsibility under the Migratory Bird Act.

In the project vicinity, and the ecoregion (Central Valley) in general, emergent wetlands are relatively scarce, and would be of high value to the evaluation species. Emergent wetland in the project area is therefore designated as Resource Category 2, with a mitigation planning goal of "no net loss of in-kind acreage or habitat values, whichever is greater".

f. <u>Annual grasslands</u>

Annual grasslands differ from woodland by lacking dominant tree cover; it appears that much of the treeless grassland found on the study area is a result of tree loss due to human activities. Perennial grass species once dominated native grasslands, but introduced annual species have largely displaced native perennial and annual grasses. Typical annual grass species are foxtail, brome, wild oats, and Italian ryegrass; native perennial grasses include needlegrasses, California onion grass, and fescue. Grassland areas provide habitat for granivorous birds such as western meadowlark, California quail, and sparrows and finches, and for California voles and pocket gophers. These areas provide important foraging habitat for breeding raptors, including red-tailed hawks, American kestrels, and great horned owls, and for wintering raptors. Lastly, waterfowl, notably Canada geese, graze on green vegetation in the grasslands adjacent to Folsom Reservoir.

The evaluation species selected for annual grasslands in the area near Folsom Reservoir are the raptor guild, and passerine ground-foraging birds (including western meadowlark, white-crowned sparrow. We have chosen these as evaluation species because: (1) raptors, as predators, play a key role in community ecology of the study area; (2) they have important human nonconsumptive benefits (e.g., birdwatching); and (3) the Service's responsibilities for many of these species protection and management under the Migratory Bird Treaty Act. While the values of these habitats vary according with season and grazing intensity, much of the grassland habitat in the study area provides medium-to-high value foraging habitat for diverse assemblages of birds of prey and ground-foraging passerine birds. Furthermore, the value of these habitats is often enhanced by their continuity with other adjacent habitats, such as wooded areas, cliffs, ponds, which provide nest and shelter sites. Grassland habitat has medium-to-high value, and is relatively abundant in the project area. Therefore, the Service finds that grasslands in the project should have a mitigation planning goal of no net loss of habitat value while minimizing loss of in-kind habitat value (i.e., Resource Category 3).

g. Sierran mixed coniferous forest

The Sierran mixed conifer forest habitat is an assemblage of conifer and hardwood species that forms a multilayered forest (Allen 1988). Dominant tree species in the project area include red fir, Douglas fir, ponderosa pine, incense cedar, sugar pine, and white fir. Shrubs include red-flowering currant, bitter cherry, western choke cherry, and snowberry (PG&E 1997). Grasses and forbs associated with this habitat include mountain brome, carex, bull thistle, iris, juncus, and needlegrass.

Large mammals (deer, bear) were chosen to evaluate Sierran mixed coniferous forest habitat because they provide consumptive and nonconsumptive recreational and other values to humans (e.g., wildlife watching, hunting). Sierran mixed coniferous habitat is a native habitat of generally high value to the evaluation species, and is today abundant in the project area and the ecoregion. The area to be disturbed by this project is small (less than ¼ acre), disturbed, and located adjacent the dam and paved road. Therefore, the Service finds that any mixed riparian coniferous forest habitat that would be impacted by the project should have a mitigation planning goal of "minimize loss of habitat value"--i.e., Resource Category 4.

h. Montane riparian

The vegetation of montane riparian scrub is variable and structurally diverse. Usually it occurs as a narrow, often dense grove of broadleaf deciduous tree species with a sparse understory (Grenfell 1988). In the Sierra Nevada, characteristic species include thinleaf alder, aspen, black cottonwood, dogwood, and willow. In the project area the habitat occurs as a intermittent stringer of willows that have fissures in the bedrock of the excavated spillway channel.

Migratory song birds were chosen to evaluate montane riparian habitat because: (1) they play multiple roles in riparian ecology, as predators, prey, and as seed dispersal agents; (2) they provide nonconsumptive recreational and other values to humans (e.g., birdwatching); and (3) the Service is responsible for protection and management of many of these species under the Migratory Bird Treaty Act. Riparian scrub habitat is a native habitat of generally high value to the evaluation species, and is fairly abundant in the ecoregion. However, the riparian scrub that would be affected by the project is a few scattered willow shrubs that have managed to establish in the spillway bedrock and have low value for the evaluation species. Therefore, the Service finds that the riparian scrub habitat that would be impacted by the project should have a mitigation planning goal of "minimize loss of in-kind habitat value"--i.e., Resource Category 4.

i. Other habitats

Disturbed habitats such as parking lots and boat ramps are highly degraded habitats. Evaluation species were not chosen, because use by wildlife is so minimal. In view of the extremely low value to most wildlife of much of these habitats in the project area, the Service finds that any highly disturbed habitats that would be impacted by the project should have a mitigation planning goal of "minimize loss of habitat value" (Resource Category 4).

B. RECOMMENDED COMPENSATION PLANS

The results and recommendations in the discussion that follows are for compensatory mitigation of impacts due to implementation of the project. They do not supersede our primary recommendation for impact avoidance, as discussed previously in this report. The results and mitigation recommendations are based on our HEP analyses (Appendix A).

Our recommended compensation plans are based on the fundamental assumption that compensatory mitigation, namely creation or restoration of the desired habitats, will succeed in replacing the habitat functions, values, and acreage lost with project implementation.

To provide assurance that any implemented compensatory mitigation measures will achieve their intended objective of replacing lost habitat values, detailed, long-term mitigation monitoring and remedial-action plans must be incorporated into the project design. These plans should include planting design, monitoring methods, specific success criteria, and remedial measures in the event of failure in meeting success criteria. The Service would be willing to participate in monitoring of construction activities, and development and implementation of the mitigation and monitoring programs.

The recommendations provided below for compensation of project impacts are based on field surveys, review of aerial photographs, review of the literature and discussions with plant ecologists and other experts familiar with the project area and its ecological processes. These plans were selected based on what the Service views as most appropriate for replacing habitat values that would be lost with the project. They are conceptual in nature, with management goals outlined in each cover-type impact section below. Mitigation site selection should be based on this conceptual framework, and designed to coincide as much as possible with the Corps' construction plans in order to minimize project costs. Adverse construction impacts at a proposed mitigation site, such as the removal of topsoil in borrow areas could, however, reduce or negate the suitability of the site for revegetation efforts. In addition, numerous site-specific factors which are currently unknown, such as groundwater depth, surface hydrology, and presence of soil contaminants, also can affect a site's suitability for restoration or creation. Therefore, compensation site selection should be considered preliminary until such time as complete evaluation of suitability of a site is completed (i.e., evaluations of soil condition, surface hydrology, groundwater depth, and conditions in regard to salinity, alkalinity or toxic substances).

The HEP evaluations of compensation sites are based upon the assumption that woody vegetation would be allowed to grow to maximum plant and canopy densities. These areas would not be disced or burned as part of any operation and maintenance plans, so predicted habitat values would be gained by this management plan. For the HEP analyses, we assumed that these areas would be free from human disturbance. If alternative areas would be used for mitigation that have greater exposure to human disturbance, the HEP analysis would need to be reviewed.

a. Construction Impact Compensation Sites (Folsom Reservoir)

The following tables (Tables 7-10) summarize the actions proposed at each hypothetical compensation site used to complete the HEP analyses. Additional information is contained in the HEP report (Appendix A).

Table 7. Oak Woodland Compensation Site Development Criteria, American River Watershed Investigation, Long-Term Evaluation, California.

OAK WOODLAND (59.4 acre compensation site)
•Acquire land. •Site is currently annual grassland. •Provide access and maintenance roads. •Plant cover crop (seed). •Construct site specific irrigation system. •Plant 400 trees per acre using 4"x4"x14" tree pots. •Plant 100% oak tree species (blue and live oak). •Provide watering, weeding, pest control as needed and monitoring reports for 3 years. •Provide general maintenance and cleanup of site in perpetuity. •Monitor plantings for 3 years and take remedial actions as needed to ensure plant establishment and overall success of the mitigation effort. •Develop O&M Manual.

b. Operation Impact Compensation Sites (Folsom Reservoir)

Since there are uncertainties on effects of inundation on vegetation and soil erosion and relatively small chances for a major flood event, it is recommended that a monitoring and adaptive management program be developed to monitor vegetation around the reservoir over the life of the project. Baseline conditions would be established and updated at intervals (10 years). After major flood events (those which encroach above the existing maximum flood pool elevation), vegetation would be surveyed and damages attributable to inundation would be mitigated as deemed appropriate using best management practices at the time (replanting on site would be the first priority).

Table 8. Oak Woodland - Gray Pine Woodland Compensation Site Development Criteria, American River Watershed Investigation, Long-Term Evaluation, California.

OAK WOODLAND-GRAY PINE WOODLAND (10.5 acre compensation site)
•Acquire land. •Site is currently annual grassland. •Provide access and maintenance roads. •Plant cover crop (seed). •Construct site specific irrigation system. •Plant 400 trees per acre using 4"x4"x14" tree pots. •Plant 90% oak tree species (blue and live oak); 10% gray pine. •Provide watering, weeding, pest control as needed and monitoring reports for 3 years. •Provide general maintenance and cleanup of site in perpetuity. •Monitor plantings for 3 years and take remedial actions as needed to ensure plant establishment and overall success of the mitigation effort. •Develop O&M Manual.

Table 9. Riparian Compensation Site Development Criteria, American River Watershed Investigation, Long-Term Evaluation, California

RIPARIAN (9.0 acre compensation site)
•Acquire land. •Site is currently annual grassland. •Provide access and maintenance roads. •Complete earthwork to facilitate seasonal natural flooding •Construct irrigation system. •Plant overstory comprised of oaks, willows and cottonwood trees using 4"x4"x14" tree pots at density of 200/acre. •Plant understory comprised of wild rose and wild grape at a density of 200/acre. •Plant cover crop (seed). •Provide watering, weeding, pest control as needed and monitoring reports for 3 years. •Provide general maintenance and cleanup of site in perpetuity. •Monitor plantings for 3 years and take remedial actions as needed to ensure plant establishment and overall success of the mitigation effort •Develop O&M Manual.

Table 10. Seasonal Wetland Compensation Site Development Criteria, American River Watershed Investigation, Long-Term Evaluation, California

SEASONAL WETLAND (0.3 acre mitigation site)
•Acquire land. •Site is currently annual grassland. •Provide access and maintenance roads •Construct wetland so that 40% of the area has water 4-9 inches deep in summer. •Plant cover crop on area disturbed from construction area. •Plant appropriate wetland species. •Provide irrigation, pest control and monitoring reports for a minimum of 3 years or until the vegetation is self-sustaining. •Provide general maintenance and cleanup of site in perpetuity. •Develop O&M Manual.

c. <u>Construction Impact Compensation Sites (French Meadows Reservoir)</u>
No specific compensation plan was identified for French Meadows Reservoir. All mitigation measures, such as replanting disturbed areas, would occur onsite.

d. <u>Operation Impact Compensation Sites (French Meadows Reservoir)</u>
No operation impacts were identified at French Meadows Reservoir.

VI. RECOMMENDATIONS

The recommendations contained within this section constitute what the Service believes, from a fish and wildlife resource perspective and consistent with our Mitigation Policy, to be the best present recommendations for the project. The outcomes of any new or renewed consultations, as required under section 7 of the Endangered Species Act or the Fish and Wildlife Coordination Act, could also affect the recommendations herein. Rationales for most of the recommendations were discussed earlier within this report.

The Council on Environmental Quality and the Service's Mitigation Policy define mitigation as including the following elements: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts. The Service considers these elements to represent the most desirable sequence of steps in the mitigation planning process.

The Service recommends the Corps implement the following preliminary recommendations if a Folsom Dam Enlargement Plan is pursued. As additional project information is developed these basic recommendations will be further refined.

<u>GENERAL</u>

1. Select a flood control alternative which avoids, to the extent possible, unmitigable impacts and minimizes other impacts to fish and wildlife resources.

2. Complete section 7 consultation with the Service pursuant to the Endangered Species Act for potential impacts to listed species.

3. Complete section 7 consultation with the NMFS pursuant to the Endangered Species Act for potential impacts to listed anadromous fish species

4. Consult with the Department of Fish and Game regarding potential impacts to State listed threatened and endangered species.

5. Develop a mitigation monitoring and remediation plan for each of the compensation sites developed for the project.

6. Avoid impacts to oak woodland, blue oak-gray pine woodland, riparian and seasonal wetlands, Sierran mixed conifer forest, and montane riparian scrub adjacent to, but outside of, construction easement areas with orange construction fencing.

7. Avoid impacts to woody vegetation at all staging areas, borrow sites, and haul routes by enclosing them with orange construction fencing.

8. Minimize impacts to annual grassland habitat and other disturbed areas, by re-seeding all disturbed areas with appropriate native grass species as construction elements are completed.

FOLSOM DAM ENLARGEMENT

Newcastle Powerhouse

9. Avoid impacts to vegetation at the Newcastle Powerhouse by confining all construction activities to the existing parking lot area.

10. Avoid impacts to water quality of Folsom Lake by taking appropriate measures to prevent construction materials (e.g., fuels, oils, lubricants, cement products) from spilling or otherwise entering the reservoir.

Folsom Dam Operation and Maintenance Bridge

11. Select an alignment which avoids woody vegetation to the extent possible.

12. Minimize impacts to annual grassland by reseeding all disturbed areas when construction is complete.

13. Compensate for the construction impacts of a temporary Folsom Dam Operation and Maintenance Bridge by acquiring suitable lands to develop 4.72 acres of oak woodland, 8.01 acres of blue oak-gray pine woodland, and 1.30 acres of riparian woodland.

Folsom Dam and Reservoir

14. Avoid impacts to water quality at Lake Natoma and Folsom Reservoir when loading, unloading, and barging borrow material to be used for dam raising by taking appropriate measures to prevent soil, fuel, oil, lubricants, etc. from entering into these waters.

15. Compensate for any vegetation losses associated with developing access to loading and unloading barges to be used for moving borrow material. Specific routes have not been determined.

16. Compensate for unavoidable impacts to oak woodland habitat by acquiring suitable lands and developing 59.41 acres of oak woodland using the guidelines in contained in Appendix A.

17. Compensate for unavoidable impacts to blue oak-gray pine woodland habitat by acquiring suitable lands and developing 10.51 acres of blue oak-gray pine woodland using the guidelines in contained in Appendix A.

18. Compensate for unavoidable impacts to riparian habitat by acquiring suitable lands and developing 9.00 acres of riparian habitat using the guidelines in contained in Appendix A.

19. Compensate for unavoidable impacts to seasonal wetland habitat by acquiring suitable lands and developing 0.30 acre of seasonal wetland habitat using the guidelines in contained in Appendix A.

20. Develop a monitoring and adaptive management program to monitor vegetation around the reservoir over the life of the project. Baseline conditions would be established and updated at intervals (10 years). After major flood events (those which encroach above the existing maximum flood pool elevation), vegetation would be surveyed and damages attributable to inundation would be mitigated as deemed appropriate using best management practices at the time (replanting on site would be the first priority).

<u>FRENCH MEADOWS RESERVOIR</u>

General

21. Avoid introduction of materials, such as fuels, hydraulic oils and lubricants, and cement products, into the reservoir or Middle Fork American River by storing/handling these types of material away from water bodies.

Spillway enlargement

22. Avoid impacts to the Sierran mixed conifer habitat to the extent possible.

23. Avoid impacts to swallow nesting (cliff and/or barn swallows) on the bridge crossing of the French Meadows spillway by removing old nests prior to March 1 and placing netting material so that they cannot construct new nests during the construction period.

24. Minimize impacts in all habitats by reseeding all disturbed soil areas with annual grasses after construction is complete (most of the area appears to be underlain with bedrock).

25. Minimize impact to aquatic resources by taking appropriate steps to prevent sediment from entering the reservoir or river.

26. Minimize impacts to nesting raptors by conducting this activity outside the breeding period, or determining there are no raptor nests in the vicinity prior to construction..

Escape channel constriction removal

27. Avoid impacts to vegetation by confining all work activities to existing roads and already disturbed areas.

28. Minimize impacts of the river crossing by constructing it in a manner which least disturbs the natural channel and streambed.

29. Minimize impacts to disturbed soil areas by reseeding such areas with annual grass species when construction is complete.

30. Minimize impacts to the river by constructing sediment barriers to prevent sediments from washing into the river during construction.

Spoil area

31. Avoid placement of spoil material on vegetated areas.

32. Minimize potential impacts to the river by constructing sediment barriers to prevent sediments from washing into the river after construction is complete.

VII. LITERATURE CITED

Allen, B. 1988. Sierran mixed conifer. *In* A Guide to Wildlife Habitats of California. California Department of Forestry and Fire Protection. Sacramento.

Barbour, M.G. 1988. California upland forests and woodlands. *In*: North American Terrestrial Vegetation, eds. M.G. Barbour and W.D. Billings. Cambridge University Press, Cambridge.

County of Sacramento. 1993. Conservation Element of the County of Sacramento General Plan. Planning and Community Development Department.

Gaines, D.A. 1977. The valley riparian forests of California: their importance to bird populations. Pages 57-85 *in* Riparian forests in California: their ecology and conservation. A. Sands, ed. University of California, Davis, Inst. of Ecology Publ. no. 15.

Grenfell Jr., W.E. 1988. Montane Riparian. *In* A Guide to Wildlife Habitats of California. California Department of Forestry and Fire Protection. Sacramento.

Holland, V.L. 1976. In defense of blue oaks. Fremontia 4:3-8.

JSA (Jones & Stokes Associates, Inc.). 2001. Technical Assistance Memorandum, Preliminary Environmental Analysis of L.L. Anderson Dam Spillway Modification dated 7/2/01, Rev.0. Sacramento, California.

MWA-JSA (Montgomery Watson Americas, Inc and Jones and Stokes Associates, Inc.). 1994. American River Flood Control Project Special Evaluation Report, Task 3, Vegetation inundation-mortality study of the proposed Auburn flood control facility.

Opler, P.A. 1974. Oaks as evolutionary islands for leaf-mining insects. Amer. Scientist 62:67-73.

PG&E (Pacific Gas and Electric Company). 1997. Evaluation for Sensitive Pants and Wildlife, Placer County Water Agency's French Meadows Reservoir Spillway Repair Project . Report No.: 001.8-97.6. San Ramon, California.

Ritter, L.V. 1988. Valley oak woodland. *In* A Guide to Wildlife Habitats of California. California Department of Forestry and Fire Protection. Sacramento.

Thompson, K. 1961. Riparian forests of the Sacramento Valley, California. Annals Assoc. American Geographers 51:294-315.

USACE (U.S. Army Corps of Engineers). 1994. Alternatives Report, American River Watershed, California. Sacramento District.

_____. 1999. Information paper for the American River Watershed. Sacramento District, Sacramento, California.

_____. 2000. American River Watershed, California. Long-Term Study, Feasibility Scoping Document, Sacramento District.

_____. 2001. American River Watershed, CA Long-Term Study. Integrated Preliminary Draft Supplemental Plan Formulation Report Environmental Impact Statement/Environmental Impact Report F4 Conference and Alternative Formulation Briefing Document. June 2001.

USFWS (U.S. Fish and Wildlife Service). 1980. Impact of water level changes on woody riparian and wetland communities. Vol. VII, Mediterranean Region: Western arid and semi-arid Region. Office of Biological Services, U.S. Fish and Wildlife Service. FWS/OBS-78/93.

_____. 1986. Potential impacts to fish and wildlife from some alternatives actions for increasing flood control along the lower American River, California. Sacramento, CA.

_____. 1991a. American River Watershed Investigation, Auburn Area, Substantiating Report. U.S. Fish and Wildlife Service, Sacramento, CA.

_____. 1991b. American River Watershed Investigation, Auburn Area, Substantiating Report, Vol. II. Appendix C: Potential vegetation and wildlife impacts of the proposed Auburn "dry" Dam. U.S. Fish and Wildlife Service, Sacramento, CA.

_____. 1991c. American River Watershed Investigation, Lower American River Area, Substantiating Report, Vol. III. U.S. Fish and Wildlife Service, Sacramento, CA.

_____. 1994. Planning Aid Report for the American River Watershed Investigation, Raising of Folsom Dam Alternative. U.S. Fish and Wildlife Service, Sacramento.

_____. 1995. Working Paper on restoration needs: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. May 9, 1995. Prepared for the U.S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, California.

_____. 1996. Final supplemental Fish and Wildlife Coordination Act Report for the American River Watershed (Flood Control) Investigation. Sacramento Fish and Wildlife Office, Sacramento, California.

Verner, J. 1988. Blue oak-digger pine. *In*: A Guide to Wildlife Habitats of California. California Department of Forestry and Fire Protection. California.

Verner, J. and A.S. Boss (tech. coords). 1980. California Wildlife and Their Habitats: Western Sierra Nevada. U.S. Dept. of Agric. Forest Service Gen. Tech. Report PSW-37. Berkeley, Calif.

APPENDIX A

AMERICAN RIVER WATERSHED INVESTIGATION
LONG-TERM STUDY

FOLSOM DAM ENLARGEMENT PLAN

HABITAT EVALUATION PROCEDURES

JULY 2001

INTRODUCTION

In section 566 of the Water Resources Development Act of 1999 (Public Law 106-53), Congress authorized the study of increasing the flood control storage at Folsom Dam and Reservoir, and downstream levee modification on the Lower American River. In compliance, the Corps of Engineers (Corps) is preparing a feasibility level document that will address the opportunities for increased flood protection through levee modification and/or increased surcharge flood control storage. Opportunities for ecosystem restoration will also be explored.

This application of Habitat Evaluation Procedures (HEP) is intended to provide a preliminary quantification of the impacts on fish and wildlife resources associated with three enlargement alternatives of Folsom Dam and Folsom Reservoir dikes on the American River, California. Any dam raise measure would be a major modification and would include features to allow Folsom Dam to pass the probable maximum flood volume without failure. It is anticipated that some modifications (physical and/or operational) of upstream storage (French Meadows Reservoir) would be needed to reduce the probable maximum flood volume. The details of these modifications have been evaluated in subsequent impact analyses (Appendix B).

PROJECT AREA

The project area is in the American River watershed, and would affect lands around Folsom Reservoir, and along the North and South Forks of the American River, which are impounded by Folsom Dam (Figure 1). The project could also affect the lower American River--the river's reach downstream of Folsom Dam.

The American River is the second largest tributary to the Sacramento River. The three forks (north, middle, and south) of the river originate in the Sierra Nevada Mountains at an elevation of about 10,400 feet (mean sea level), and generally flow in a southwesterly direction. The Middle Fork joins the North Fork near the City of Auburn, just upstream of Folsom Reservoir; the North Fork then joins the South Fork just upstream of Folsom Dam (Figure 1). All three forks of the American River above Folsom Reservoir are nationally popular areas for whitewater sports, and the reach of the South Fork from Coloma to the reservoir is the state's most popular whitewater rafting run.

Folsom Dam, located near the city of Folsom, is a multi-purpose dam built by the Corps in 1955, and operated by the Bureau of Reclamation (Reclamation). It is the largest of about 20 dams in the American River watershed and, except for Nimbus Dam, is the furthest downstream. Five reservoirs in the upper American River watershed (Loon Lake, Ice House, Union Valley, French Meadows, and Hell Hole) represent 90% of the existing storage capacity upstream of Folsom Reservoir.

The main dam is a 345-foot high concrete gravity dam across the American River channel. Associated with Folsom Dam is a series of auxiliary dams and dikes which span topographic lows; these structures are needed to contain the reservoir. Mormon Island Dam is the largest of these structures, and is located on the southeast end of the reservoir, in Blue Ravine (Figure 2). Folsom Reservoir blocks about 20 miles of the North Fork and 10 miles of the South Fork, and has a total storage capacity of 974,000 acre-feet, which fills the reservoir to an elevation of 466 feet above mean sea level (msl).

Reclamation operates Folsom Dam as an integrated component of the Central Valley Project. The dam's primary purposes have been to: provide flood control; provide instream flows; manage Sacramento-San Joaquin Delta water quality; produce hydropower; provide recreation; and more recently, protection and restoration of the region's fish and wildlife resources.

PROJECT DESCRIPTION

The improvements would be designed so that they could be constructed and operated without affecting ongoing water conservation and hydropower operations. The plan would maintain the current Folsom Dam design flood control release of 115,000 cubic feet per second (cfs) and an emergency release of 160,000 cfs. Three scales of enlargement alternatives were developed using maximum flood control pool elevations of 478, 482, and 487 feet msl. The probability of flooding in Sacramento from levee failure would be reduced from 1 chance in 140[2] in any one year (1-in-164 chance with completion and implementation of the Folsom Flood Management Plan which would institute advanced release) to 1 chance in 189 (flood pool elevation 478); 1 chance in 213 (flood pool elevation 478); or 1 chance in 233 (flood pool elevation 487) in any one year with moderate advanced release.

Several constraints were imposed on plan formulation for Folsom Dam raising, these are:
- dam raise measures are solely for flood control as stipulated in section 566 of WRDA 1999.
- dam raise measures are to avoid disruptions to the normal operation of Folsom Dam for water supply, hydropower, and flood control.
- no loss of flood protection from existing flood damage reduction projects is permitted.
- minimize disturbance of habitat for threatened and endangered species.

The no action alternative serves as the base against which the proposed flood protection alternatives will be evaluated to determine effectiveness and to identify effects that would result from them. Several actions that are currently authorized are expected to be completed prior to implementation of any Long-Term Evaluation project (USACE 2000). Therefore, the effects and benefits associated with these actions are part of the no-action condition. See the accompanying Fish and Wildlife Coordination Act report for a complete description of the no action condition.

The three construction alternatives under consideration for the Folsom Dam Enlargement Plan are described briefly below.

a. **<u>3.5-foot raise with a 478-foot pool elevation</u>**. This alternative would include several actions: (a) replacement of the eight existing spillway gates; (b) lowering of the spillway 6

[2] After the Common Features and Folsom Modifications Projects are completed.

feet and modification of the bridge piers to anchor the new gates; (c) replacement of the existing eight-span spillway bridge; (d) raising the concrete dam 3.5 feet with parapet walls; (e) raising embankment dams and dikes with a 3.5-foot-high concrete wall and extending the existing slurry walls in Mormon Island Dam and Dikes 5 and 7; (f) constructing a 7-foot-high parapet wall around the Newcastle Powerhouse; (g) constructing a temporary Folsom Dam operation and maintenance bridge (about ¼-mile in length); (h) modifying of the existing elevator tower; (i) purchasing flood easements on seven properties along Mooney Ridge in Granite Bay; (j) modifying the L.L. Anderson Dam (French Meadows Reservoir) spillway so that the dam can safely pass the probable maximum flood; and (k) some additional structural work on Folsom Dam (such as replacement of the gantry crane, modification of the penstock wheel gates, hydraulic control units, etc).

Borrow areas for the embankment materials have been identified at the peninsula between the north and south forks of the American River at Folsom Lake, and Mississippi Bar which is located upstream and north of Nimbus Dam. The peninsula material (23,000 cubic yards; 90 acres) would be barged across Folsom Lake and the Mississippi Bar material (42,100 cubic yards; 140 acres) would be trucked on existing surface roads to the construction site. Staging areas have been selected immediately adjacent to the construction sites (Mormon Island Dam, the main dam, Dike 6, Dike 4, Dike 3, and Dike 1) and located to avoid or minimize vegetation disturbance.

Additional lands would need to be acquired at a few locations where the enlarged flood pool would extend beyond the Federal Project boundary and for mitigation of environmental impacts at the borrow sites and construction areas.

L.L. Anderson Dam is owned by the Placer County Water Agency and is located on the Middle Fork of the American River above Folsom Dam. The embankment dam has inadequate spillway capacity and would overtop and fail during a probable maximum flood event. This failure would add about 250,000 cfs to the probable maximum flood at Folsom Dam. Providing for passage of that additional flow at Folsom Dam would be considerably more expensive than modifying L.L. Anderson Dam and spillway for safe passage of the probable maximum flood event.

The following modifications are proposed for L.L. Anderson Dam: (a) remove the existing two-tainter-gate ogee crest control structure and replace it with a new three-tainter-gate ogee crest control structure at a new designed spillway entrance; (b) deepen (about 23 feet) and extend (about 100 feet) the existing rock excavated spillway channel, (c) widen two constriction points in the spillway escape channel; and (d) raise (to a maximum 3.6 feet high) and extend (about 1,400 feet) the existing parapet wall. The excavated material would be placed at an existing disposal area adjacent the spillway escape channel.

The 3.5-foot raise alternative at Folsom Dam would increase the flood storage capacity by 47,000 acre-feet and allow revision of the dam reoperation variable flood control space to a total range of 447,00-647,000 acre-feet. Water releases at the dam are made through the gated outlets at the lower level of the dam. Releases are restricted to the capacity of the discharge structures and by existing operation criteria that limits the increases in release rates. The lower level outlet capacity will be 115,000 cubic feet second (cfs) once the Folsom Modifications Project is complete. The reservoir begins to fill once inflow exceeds this outflow capacity. The outflow rate remains at 115,000 cfs until the water level reaches the spillway crest, at which time spillway releases from the main gates can begin. The maximum emergency release is 160,000 cfs with a maximum duration of 48 hours. The reservoir water surface elevation could raise from elevation 474 to 478 at infrequent intervals, the expected duration of such events above elevation 474 would be at most 1 day (USACE 2001)

b. **<u>8.5-foot raise with a 482-foot pool elevation</u>**. This plan is the similar to the above plan except that: (a) the raise would be accomplished by raising the concrete monolith and embankments and adding a 3.5 foot parapet wall; (b) the spillway would not have to be lowered; (c) the floodwall constructed at the Newcastle Powerhouse would be about 12 feet high; (d) about a -mile of Folsom Dam Road, southeast of the left wing dam, would be raised to avoid inundation; and (e) about 90 acres (55,300 cubic yards) of the Peninsula borrow site, and 140 acres (277,000 cubic yards) of the Mississippi Bar site would be used for construction material.

The top of flood pool elevation is limited to 482 feet as this is the maximum normal operation that meets dam stability criteria (USACE 2001). This alternative would increase the reservoir flood storage capacity by 95,000 acre-feet and would allow revision of the dam reoperation variable flood space to a total range of 495,000-695,000 acre-feet. The same operation limits as discussed for the 3.5-foot raise also apply to this alternative.

c. **<u>12-foot raise with a 487-foot pool elevation</u>**. This plan is the same as the 8.5 foot raise plan above, plus: (a) new high-strength post-tensioned steel cables would be cored and grouted into the pier/dam section to provide for trunnion anchorage when replacing the spillway gates; (b) piers would be raised and extended downstream to anchor the new larger radial gates when modifying the spillway bridge piers; (c) the concrete dam would be raised 12 feet; (d) post-tensioned tendons would be used to anchor the dam’s concrete mass to the bedrock; (e) the floodwall at the Newcastle Powerhouse would be about 16 feet high; (f) about 90 acres (140,000 cubic yards) of the Peninsula borrow site, and 140 acres (855,000 cubic yards) of the Mississippi Bar site would be used for construction material; and (g) six of the properties would have flowage easement s purchased and one property would be acquired in fee title.

This alternative would increase the flood storage capacity at Folsom Reservoir by 157,000 acre-feet. It also represents the maximum feasible amount of dam raise possible before a higher level of extensive modifications of the structure would be required, including foundation work that would require dewatering the reservoir. The dam’s reoperation variable flood space would have a total range of 557,000-757,000 acre-feet. The same operation limits as discussed for the 3.5-foot and 8.5-foot raises also apply to this alternative.

METHODOLOGY

HEP is a methodology developed by the Fish and Wildlife Service (Service) and other State and Federal resource and water development agencies which can be used to document the quality and quantity of available habitat for selected fish and wildlife species. HEP provides information for two general types of habitat comparisons: (1) the relative value of different areas at the same point in time; and (2) the relative value of the same areas at future points in time. By combining the two types of comparisons, the impacts of proposed or anticipated land-use and water-use changes on habitat can be quantified. In a similar manner, any compensation needs (in terms of acreage) for the project can also be quantified, provided a mitigation plan has been developed for specific alternative mitigation sites.

A HEP application is based on the assumption that the value of a habitat for selected species or the value of a community can be described in a model which produces a Habitat Suitability Index (HSI). This HSI value (from 0.0 to 1.0) is multiplied by the area of available habitat to obtain Habitat Units (HUs). The HUs and Average Annual Habitat Units (AAHUs) over the life of the project are then used in the comparisons described above.

The reliability of a HEP application and the significance of HUs are directly dependent on the ability of the user to assign a well-defined and accurate HSI to the selected evaluation elements or communities. Also, a user must be able to identify and measure the area of each distinct habitat being utilized by fish and wildlife species within the project area. Both the HSIs and the habitat acreage must also be reasonably estimable at various future points in time. The HEP team[3], comprised of Corps, Sacramento Area Flood Control Agency (SAFCA), and Service staff, determined that these HEP criteria could be met, or at least reasonably approximated, for the Folsom Dam Enlargement Plan of the American River Watershed Investigation, Long-Term Study. Thus HEP was considered an appropriate analytical tool to analyze impacts of the proposed project alternatives[4].

GENERAL HEP ASSUMPTIONS

Some general assumptions are necessary to use HEP and Habitat Suitability Index (HSI) Models in the impact assessment:

<u>Use of HEP:</u>

[3] The National Marine Fisheries Service and California Departments of Water Resources and Fish and Game were provided copies of the initial assumptions and procedures package for the HEP, but were unable to actively participate in the HEP.

[4] For further information on HEP see ESM 100-104 which is available from the Service's Sacramento Fish and Wildlife Office.

- HEP is the preferred method to evaluate the impacts of the proposed project on fish and/or wildlife resources.
- HEP is a suitable methodology for quantifying project-induced impacts to fish and wildlife habitats.
- Quality and quantity of fish and wildlife habitat can generally be numerically described using the indices derived from the HSI models and associated habitat units.
- The HEP assessment is applicable to the habitat types being evaluated.

Use of HSI Models

- HSI models are hypotheses based on available data.
- HSI models are conceptual models and may not measure all ecological factors that affect the quality of a given cover-type for the evaluation species (e.g. vulnerability to predation). In some cases, assumptions may need to be made by the HEP Team and incorporated into the analysis to account for loss of those factors not reflected by the model.

The HEP field work for the Folsom Dam raise portion of the project was completed by staff from the Service's Sacramento Fish and Wildlife Office and the Corps and occurred in the October and November of 2000 and February of 2001. Seven cover-types would be impacted by the project: oak woodland, blue oak-gray pine woodland, riparian woodland, chaparral, seasonal wetland, annual grassland, and other lands (comprised of roads, parking lots, park lands, bare ground, gravel bars, etc.). These cover-types were mapped from the reservoir by boat[5] or vehicle on enlargements of orthophotos extracted from AirPhoto USA images flown in July 1999. The scale of the enlarged photographs was 1 inch = 200 feet. These maps were then provided to the Corps' GIS (Geographic Information System) Unit which constructed polygons in ArcView and determined area using the software. Some errors in referencing of the image on the maps were discovered, so the Corps' GIS staff made corrections to the mapping to account for the image error. Discrepancies found on overlapping maps were corrected using the image and similar areas found nearby. Impacts to these cover-types were categorized as permanent and temporal (including inundation related). The acreage of each affected cover-type is summarized in Table 1.

The construction alignment for the temporary operation and maintenance bridge just downstream of Folsom Dam and placement of a floodwall at the Newcastle Powerhouse were given a preliminary analysis for environmental impacts in April 2001 and reaffirmed in June 2001.

Nine HSI models were used in this HEP application to quantify project impacts. The models and the cover-type to which they were applied is summarized in Table 2. The western gray squirrel and plain titmouse models were chosen to evaluate the project impacts to oak woodland and blue

---

[5] Folsom Reservoir Water surface elevation during the mapping period was 429 msl, so in many areas the vegetation was a considerable distance, or out of direct sight, from the water. When this occurred, the area was walked or driven to, or interpreted from the aerial photograph based on observable adjacent vegetation.

Table 1. Cover-types and acreage that would be impacted by the American River Watershed Investigation, Long-Term Evaluation, Folsom Dam Enlargement Plan alternatives.

FEATURE (LOCATION)	COVER-TYPE	ACREAGE		
		3.5-foot raise 478 Pool	8.5-foot raise 482 Pool	12-foot raise 487 Pool
Folsom Dam and auxiliary dams and dikes (permanent impacts)	Blue oak - gray pine	3.8	3.8	3.8
	Oak woodland	21.4	21.4	21.4
	Riparian woodland	9.0	9.0	9.0
	Seasonal wetlands	0.3	0.3	0.3
	Annual grassland	80.0	80.0	80.0
	Other[1]	152.2	152.2	152.2
	SUBTOTAL	266.7	266.7	266.7
Folsom Reservoir (operations)	Blue oak - gray pine	283.7	367.3	469.7
	Oak woodland	205.2	264.2	350.0
	Riparian woodland	20.9	24.5	30.8
	Chaparral[2]	20.1	28.7	38.7
	Seasonal wetlands	2.6	2.6	2.9
	Annual grassland	80.5	106.5	172.7
	Other[1]	165.7	210.7	240.6
	SUBTOTAL	778.7	1,004.5	1,304.9
Newcastle Powerhouse	Other[1]	~ 1.0	~ 1.0	~ 1.0
	SUBTOTAL			
Folsom Dam O&M Bridge	Blue oak - gray pine	2.9	2.9	2.9
	Oak woodland	1.7	1.7	1.7
	Riparian woodland	1.3	1.3	1.3
	Annual Grassland	0.5	0.5	0.5
	Other[1]	4.6	4.6	4.6
	SUBTOTAL	11.0	11.0	11.0
	TOTAL	1,057.4	1,283.2	1,583.6

1. Other = roads, parking lots, structures, riprap, bare ground, gravel bars, etc.
2. Chaparral cover-type would be impacted by efforts to raise Salmon Falls Bridge and possibly inundation impacts from use of the enlarged flood pool.
3. The specific details of construction at the Newcastle Powerhouse are unknown. However, all construction activities, including staging, are expected to be confined to the existing parking lot.

oak-gray pine woodland cover-types. These species were selected because they are both cavity nesters. The gray squirrel feeds both in trees an on the ground and prefers fairly dense canopy cover from mature trees, particularly those which produce hard mast. The titmouse prefers to inhabit areas with a tree canopy dominated by blue, live, and valley oaks. The titmouse is primarily a bark forager, although it also forages on tree foliage and occasionally the ground. Most foraging is done within 30 feet of the ground and a preference for blue oaks has been shown.

Table 2. HEP Cover-types, proposed HSI models, and HSI model variables for the American River Watershed Investigation, Long-Term Study, Folsom Dam Enlargement Plan alternatives.

COVER-TYPE	PROPOSED HSI MODELS	HSI MODEL VARIABLES
(1) Blue oak - gray pine woodland	Western gray squirrel	V1 - Canopy closure of mast-producing species >5m tall V2 - Density of leaf litter layer V3 - Tree canopy cover V4 - Den site availability per acre
	Plain titmouse	V1 - Tree diameter V2 - Trees per acre V3 - % composition of tree species that are oaks
(2) Oak woodland	Western gray squirrel	V1 - Canopy closure of mast-producing species >5m tall V2 - Density of leaf litter layer V3 - Tree canopy cover V4 - Den site availability per acre
	Plain titmouse	V1 - Tree diameter V2 - Trees per acre V3 - % composition of tree species that are oaks
(3) Riparian woodland	Great horned owl	V1 - % herbaceous canopy cover V2 - % herbaceous growth between 6 and 36 inches tall V4 - % shrub crown cover V6 - Forest overstory size class V7 - Size of forested areas
(4) Chaparral	Bobcat (1987)	V1 - % shrub cover V2 - % herbaceous cover V3 - Degree of patchiness V4 - Presence of rock outcroppings
	Wrentit	V1 - % shrub cover V2 - Shrub cover #5 feet
	California thrasher	V1 - Presence of low shrub openings V2 - Shrub/seedling cover
(5) Seasonal wetlands	Great egret (feeding)	V1 - Percentage of area with water 4-9 inches deep V2 - Percentage of submerged or emergent vegetation cover in zone 4-9 inches deep
	California vole	V1 - Height of herbaceous vegetation V2 - Percent cover of herbaceous vegetation V3 - Soil type V4 - Presence of logs and other types of cover

	Red-winged blackbird	V1 - Predominance of narrow or broadleaf monocots V2 - Water presence throughout the year V3 - Presence or absence of carp V4 - Presence or absence of damselflies or dragonflies V5 - Mix of herbaceous vegetation V6 - Suitability of foraging substrate
(6) Annual grassland	HEP not conducted; disturbed area will be reseeded after construction work is complete.	
(7) Other	HEP not conducted	

The great horned owl model was selected to evaluate the project impacts to the riparian cover-type because it forages in open areas with sufficient and suitable herbaceous or shrub cover to support prey species as found in the riparian areas in the project area. It also uses wooded areas for nesting and cover, the larger ($20 acres) and more mature (tree diameter at breast height (dbh) $20 inches) the wooded area the more suitable it is for this species.

The bobcat, wrentit, and California thrasher were selected for evaluating the project impacts to the chaparral cover-type because they utilize the shrub and herbaceous components of the cover-type to fulfill their life requisites for feeding, cover, and reproduction.

FIELD SAMPLING AND DATA COLLECTION

The HEP Team determined that direct construction impacts are those that would cause immediate and complete loss of habitat values at a particular site at the time of project construction. These immediate impacts would occur in the footprint area of the enlarged facilities and within all temporary and permanent construction easement areas. The HEP Team determined temporary construction easement areas would be permanently impacted, since the Corps could not guarantee trees or other woody vegetation impacted in these areas would be re-established after construction was completed. Impacts to herbaceous vegetation that would occur within staging and borrow areas would be temporary, as these areas are typically reseeded after construction. The HEP Team assumed that all woody vegetation at, or adjacent to, the staging and borrow sites would be avoided. If this assumption proves to be incorrect then additional impact analyses will be required. Impacts to herbaceous vegetation on the slopes of raised levees and stability berms that would not undergo revetment would also be temporary.

Data for the oak woodland/oak woodland-gray pine cover-type impacts were collected using a 50-foot-long by 15-foot-wide belt transect at the sample site. At reservoir sites, the transect was laid out perpendicular to the reservoir high water mark as determined by the sampling teams (usually the highest line of debris or erosion). Using line-intercept techniques, the canopy cover of hard mast producing trees and shrubs, the canopy cover of all trees, and leaf litter were recorded. Dbh of all trees in the belt transect was measured using either a dbh tape or Biltmore stick. All oak trees were noted on the data sheet.

Data for the riparian cover-type were collected using a 25-meter-long by 5-meter-wide belt transect at the sample site. Using line-intercept techniques, the herbaceous canopy cover, herbaceous vegetation height, and shrub crown cover were recorded. Dbh of all trees in the belt transect was measured using either a dbh tape or Biltmore stick.

Data for the chaparral cover-type were collected using a 50-meter-long transect at the sample site. Using line-intercept techniques, the herbaceous canopy cover, shrub canopy cover, shrub/seedling cover, and shrub height were recorded. The presence of rock outcroppings and low shrub openings were determined visually at each sample site and cover-type diversity was estimated by the sampling teams.

Data for the seasonal wetland cover-type were collected using a 25-meter-long transect at the sample site. Using line-intercept techniques, the herbaceous vegetation height, water depth and submergent/emergent vegetation cover in water 4-9 inches deep was recorded. A check-list for the remaining variables was constructed and a check mark was placed to indicate the conditions observed for the particular variable.

The number of sample sites needed to adequately represent the value of each cover-type for the evaluation species was determined by the HEP Team, and was based on the acreage and the degree of heterogeneity of the cover-type being sampled. The HEP Team found that some variables could be visually estimated with an acceptable level of accuracy by direct observations in the field. In either case, the measured or estimated value(s) for each variable was recorded on data sheets.

As previously mentioned, when using HEP, it is necessary to determine HSIs for each evaluation species at selected target years, including future years, for both with-project and without-project scenarios, and for proposed mitigation areas. Since it is not possible to empirically determine habitat quality and quantity for future years, future HSI values were projected. This was accomplished by increasing or decreasing the measured baseline SI values for each evaluation species, according to probable future conditions; consideration of the HSI model variables; literature review; professional observations; and review of completed restoration and revegetation projects. A summary of these predicted conditions appears in Appendix A-1.

HSI values for all evaluation species were calculated at the completion of field data collection. All SIs and HSIs were calculated by hand, or using a calculator, as appropriate. The equations used to calculate HSIs are contained within each model. The assumptions used in predicting habitat changes in future Target Years and the predicted future scenarios are contained in Appendix A-1.

Potential compensation sites were also evaluated using HEP procedures to quantify the habitat values which could be developed on a site for each of the cover-types impacted. The HEP Team decided to choose annual grassland areas and convert them to the appropriate cover-type. It was assumed the compensation sites would not currently support any woody vegetation and would be capable of supporting the cover-type proposed for the site (i.e., a site would have the appropriate hydrology to support seasonal wetlands or riparian cover-types). The candidate sites included lands near Mississippi Bar adjacent Lake Natoma, downstream of Folsom Dam; lands adjacent and within the Mormon Island Preserve wetlands near Mormon Island Dam; and lands around Folsom Lake within the existing State and Federal property boundaries. The assumptions used to develop the compensation site scenarios are listed in Appendix A-1 for each cover-type under MP2-Management Area-Future With Project (Compensation Site).

The HEP version 2.2 Accounting Software package was used on an IBM-compatible personal computer to calculate HUs, AAHUs, and sizes of the compensation areas needed to offset project impacts to fish and wildlife, for all cover-types evaluated. Copies of the HSI models used for the HEP are available from the Sacramento Fish and Wildlife Office.

RESULTS AND DISCUSSION

This HEP analyzed the potential impacts of the proposed raising of Folsom Dam. Impact areas were divided into four components to facilitate possible design changes and subsequent impact analyses as the planning process proceeds toward selection of a construction alternative. The components are: (1) the construction footprint of the enlarged facilities (including temporary and permanent construction easements); (2) impacts associated with constructing a wall around the Newcastle Powerhouse; (3) construction of a temporary operation and maintenance road bridge across the American River just downstream of Folsom Dam; and (4) the potential impacts to vegetation in the new reservoir inundation zone.

The HEP does not address potential impacts to aquatic resources at Folsom Reservoir during construction, nor are potential lower American River fishery impacts addressed for the construction period or subsequent reservoir operation.

Folsom Dam Enlargement/Construction Impacts.

The direct impacts and compensation needed for enlarging Folsom Dam either 3.5, 8.5, or 12 feet are summarized in Table 3. A specific compensation site was not analyzed in this HEP application. Instead a typical site was developed, and assumptions were made that the site would be an annual grassland area without existing woody vegetation for a baseline condition. For the riparian and seasonal wetland cover-types, a critical assumption was made that any site selected for compensation would require the appropriate hydrology to support these cover-types. The HEP noted that suitable lands for oak woodland, blue oak-gray pine woodland, and riparian were observed at Mississippi Bar, Mormon Island Dam, and other lands around the reservoir owned by the Federal or State government. It should also be noted that the proposed staging areas for this construction were not analyzed for impacts because they were all located at bare ground areas

Table 3. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units With- and Without-Project, and Compensation Need for the direct impacts of construction of the Folsom Dam Enlargement Alternatives of the American River Watershed Investigation, Long-Term Evaluation, California.

Folsom Dam and Auxiliary Dam and dikes raised 3.5, 8.5, or 12 feet (pool elevations 478, 482, or 487).					
Cover-Type	Acres Impacted	AAHUs W/O Project	AAHUs W/ Project	Net Change in AAHUs	Compensation Need
Blue oak - gray pine woodland	3.8	5.02	0.29	-4.73	10.50
Oak woodland	21.4	19.26	1.59	-17.67	59.41
Riparian woodland	9.0	2.43	0.01	-2.42	9.00
Seasonal wetland	0.3	0.39	0.26	-0.13	0.30
Annual grassland	80.0	N/A	N/A	N/A	Re-plant
Other	152.2	N/A	N/A	N/A	N/A
TOTAL	266.7				**79.21**

within the existing reservoir pool or annual grassland which would be re-planted after construction.

Newcastle Powerhouse

A floodwall either 7-, 12-, or 16-feet-high would be constructed depending on the dam raise alternative selected. All of the work (staging, construction easements, etc. would be confined to the existing parking lot and roads at the powerhouse. There should be no impact to fish and wildlife resources if this plan does not change.

Folsom Dam Maintenance and Operation Road and Bridge

The Corps provided an enlarged aerial photograph of the currently proposed footprint and construction easement of the temporary operation and maintenance road and bridge on March 26, 2001. The HEP Team subsequently conducted a site review and cover-typed the footprint area on the photograph. Since this alignment was considered preliminary and intersected numerous patches of oak woodland and riparian cover-types, the HEP Team requested that the Corps consider a minor realignment to utilize an existing dirt/gravel/paved road to avoid this vegetation. The Corps concurred and realigned the bridge and approach roads. The vegetation was mapped by comparing the original mapping to the new alignment and interpreting the cover-types present. The cover-types impacted with the revised alignment are summarized in Table 4. The new alignment has not been groundtruthed by the HEP Team.

The compensatory mitigation for constructing a temporary maintenance road and bridge was developed using the results of the HEP data collected for the Folsom Dam raising impacts. The ratio of compensation need to acres impacted for each cover-type (Table 3) was used to generate the compensation figure for each of the cover-types impacted by the road and bridge proposal. The compensation needs is summarized in Table 4 by cover-type. The HEP Team considered

Table 4. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units With- and Without-Project, and Compensation Need for the construction of the temporary Folsom Dam Operation and Maintenance Road and Bridge of the American River Watershed Investigation, California.

Folsom Dam Operation and Maintenance Road and Bridge					
Cover-Type	Acres Impacted	AAHUs W/O Project	AAHUs W/ Project	Net Change in AAHUs	Compensation Need
Oak woodland	1.7	1.53	0.13	-1.40	4.72
Riparian woodland	1.3	0.35	0.01	-0.34	1.30
Blue oak/Gray Pine Woodland	2.9	3.83	0.22	-3.61	8.01
Annual grassland	0.5	N/A	N/A	N/A	Re-plant
Other	4.6	N/A	N/A	N/A	N/A
TOTAL	11.0				**14.03**

this approach to be acceptable to since the road and bridge alignment is very preliminary and will likely change in the future.

Folsom Reservoir Inundation

Between 778 and 1,305 acres would be affected by enlarging Folsom Dam, depending on which dam raise alternative is selected. Some of these lands are already developed or otherwise disturbed habitat which provides little or no value for wildlife species, and some support vegetation that is tolerant of flooding. Table 5 summarizes the acreage of each habitat which provides value for wildlife and is expected to receive inundation over the life of the project. Inundation effects around Folsom Reservoir would occur in large part by the frequency, timing, and duration of flooding. Studies to date indicate that predicting the effects of inundation on vegetation is not straightforward. The raising of Folsom Dam would have potential for two significant impacts on vegetation: (1) changes in vegetation composition caused by inundation affecting survival and reproduction of vegetation within the zone between current and proposed maximum reservoir levels; and (2) effects of inundation on soil erosion and slippage, especially on steep slopes as are found along the upper reservoir and the forks of the American River.

The vegetation types exposed to flooding are not, in general, highly tolerant of flooding. With the exception of riparian and riverine habitats, natural flooding does not occur in the areas which would be flooded by raising Folsom Dam. Studies of the effects of inundation on blue oaks (Harris et al. 1969, 1975 *in* USFWS 1980; MWA-JSA 1994) have found that blue oaks can survive some flooding, but may be sensitive to periods of inundation of as little as 7 days. It is not clear from these studies, however, at what time of year flooding occurred, and the ability of vegetation to tolerate inundation depends on the time of year. For example, deciduous trees, such as oaks, tend to be much more sensitive to flooding during their period of active growth (i.e., in the spring), while winter-dormant plants appear to be more tolerant of flooding (USFWS 1980). Folsom Reservoir can reasonably be expected to fill during a major spring flood event, when oaks are actively growing. The absence of blue oaks within the current inundation zone of

Table 5. Summary of cover-types and their acreage which would be inundated at Folsom Reservoir at full flood pool if Folsom Dam were raised 3.5, 8.5, or 12 feet as part of the American River Watershed Investigation, California.

PROJECT FEATURE	COVER-TYPE	ACREAGE		
		3.5-foot raise 478 Pool	8.5-foot raise 482 Pool	12-foot raise 487 Pool
Folsom Reservoir (operations)	Blue oak - gray pine	283.7	367.3	469.7
	Oak woodland	205.2	264.2	350.0
	Riparian woodland	20.9	24.5	30.8
	Chaparral	20.1	28.7	38.7
	Seasonal wetlands	2.6	2.6	2.9
	Annual grassland	80.5	106.5	172.7
	SUBTOTAL	612.3	793.8	1,064.8

Folsom Reservoir and other foothill impoundments indicates that blue oaks cannot tolerate the flooding regime existing there. Further, evergreen species, including gray pines and live oaks, occur commonly around the reservoir, and tend to be more sensitive to inundation than deciduous trees such as blue oaks (MWA-JSA 1994).

The Corps has developed preliminary data (most recent version is dated March 9, 2001) on water surface elevation and computed probability and duration (hours or days) for 10 alternative floods ranging from a 50 to the 500-year event. This information (days and hours version) is shown in Tables 6 and 7. A worst case scenario for vegetation in the new storage area is a reservoir at maximum flood pool (487 elevation) for 1 day (13 hours) and 3 days (65 hours) at an elevation just above existing conditions during a 500-year flood event. This is 13 and 39 hours above baseline conditions, respectively. During a 200-year event, water would not reach elevation 487 and the lower zone would again be inundated for a maximum of 3 days (66 hours), or 46 hours over the baseline condition. The estimated drawdown rate for a 200-year event would be about 0.044 feet/hour in the lower zone (elevation 470-478) (JSA 2001b).

The other factor which could affect vegetation is erosion of the saturated soil in the new inundation area during a flood event from the water being drawn down or wind driven wave wash during a major storm event. Slopes in the Folsom Reservoir area are generally between 5 and 25% (USACE 2001). Slopes in the Mooney Ridge area in the northwestern corner of the reservoir and the shoreline just west of the South Fork of the American River exceed 30% (USACE 2001). It is likely that during a major flood event some, or all, of the soil on steep slopes would experience some erosion. The extent of erosion and its effect on vegetation would be difficult to predict.

The cover-types and their acreage which would likely be adversely affected over the life of the project is summarized in Table 8. Annual grassland is included due to the potential effects of erosion

PRELIMINARY

TABLE 6
ELEVATION, COMPUTED PROBABILITY AND DURATION OF INUNDATION (DAYS)
(ADVANCE RELEASE CONDITION)

Alternatives		Event									
		500	300	250	225	200	175	150	125	100	50
Probability of exceeding event in any		0.20%	0.33%	0.40%	0.44%	0.50%	0.57%	0.67%	0.80%	1%	2%
Max Event Elev	Existing	477.86	475.06	475.19	475.03	474.66	474.08	474.01	473.62	472.51	470.57
	474	476.63	475.14	474.77	474.43	473.99	473.75	473.53	471.49	464.04	452.39
	478	477.84	477.20	476.60	476.40	476.09	475.52	475.27	466.78	458.58	435.94
	482	481.09	480.72	480.57	480.00	479.65	478.35	476.73	466.78	458.58	435.94
	487	486.69	485.40	484.69	483.66	479.83	475.07	472.78	462.62	454.74	434.95
Max Duration (days) 466-470	Existing	2	1	1	1	2	2	2	2	2	2
	474	1	1	1	2	2	2	2	2	0	0
	478	1	2	2	2	3	3	2	1	0	0
	482	2	3	3	3	3	3	2	1	0	0
	487	3	4	4	4	3	3	1	0	0	0
Max Duration (days) 470-478	Existing	1	1	1	1	1	1	1	1	1	0
	474	1	1	1	1	1	1	1	1	0	0
	478	1	1	1	1	2	2	1	0	0	0
	482	1	2	3	3	3	2	1	0	0	0
	487	3	4	4	3	3	2	0	0	0	0
Max Duration (days) 478-482	Existing	0	0	0	0	0	0	0	0	0	0
	474	0	0	0	0	0	0	0	0	0	0
	478	0	0	0	0	0	0	0	0	0	0
	482	0	1	1	1	1	0	0	0	0	0
	487	1	2	2	2	1	0	0	0	0	0
Max Duration (days) 482-487	Existing	0	0	0	0	0	0	0	0	0	0
	474	0	0	0	0	0	0	0	0	0	0
	478	0	0	0	0	0	0	0	0	0	0
	482	0	0	0	0	0	0	0	0	0	0
	487	1	1	1	1	0	0	0	0	0	0

Duration of innundation by elevation bands at the dam site, gross pool at 466 feet.

PRELIMINARY

TABLE 7
ELEVATION, COMPUTED PROBABILITY AND DURATION OF INUNDATION (HOURS)
(ADVANCE RELEASE CONDITION)

Alternatives		Event									
		500	300	250	225	200	175	150	125	100	50
Probability of exceeding event in any		0.20%	0.33%	0.40%	0.44%	0.50%	0.57%	0.67%	0.80%	1%	2%
Max Event Elev	Existing	477.86	475.06	475.19	475.03	474.66	474.08	474.01	473.62	472.51	470.57
	474	476.63	475.14	474.77	474.43	473.99	473.75	473.53	471.49	464.04	452.39
	478	477.84	477.20	476.60	476.40	476.09	475.52	475.27	466.78	458.58	435.94
	482	481.09	480.72	480.57	480.00	479.65	478.35	476.73	466.78	458.58	435.94
	487	486.69	485.40	484.69	483.66	479.83	475.07	472.78	462.62	454.74	434.95
Max Duration (hours) 466-470	Existing	41	32	32	35	38	41	44	48	45	36
	474	34	32	34	36	42	51	52	44	0	0
	478	35	46	55	56	63	62	53	14	0	0
	482	46	69	75	76	76	72	53	14	0	0
	487	82	104	105	107	81	61	33	0	0	0
Max Duration (hours) 470-478	Existing	26	17	18	18	18	19	20	25	23	11
	474	22	17	18	17	20	27	31	20	0	0
	478	21	26	32	33	47	48	33	0	0	0
	482	28	53	62	64	64	59	33	0	0	0
	487	65	85	86	83	66	47	0	0	0	0
Max Duration (hours) 478-482	Existing	0	0	0	0	0	0	0	0	0	0
	474	0	0	0	0	0	0	0	0	0	0
	478	0	0	0	0	0	0	0	0	0	0
	482	8	13	19	20	21	10	0	0	0	0
	487	27	52	54	52	28	0	0	0	0	0
Max Duration (hours) 482-487	Existing	0	0	0	0	0	0	0	0	0	0
	474	0	0	0	0	0	0	0	0	0	0
	478	0	0	0	0	0	0	0	0	0	0
	482	0	0	0	0	0	0	0	0	0	0
	487	13	27	29	25	0	0	0	0	0	0

Duration of innundation by elevation bands at the dam site, gross pool at 466 feet.

Source: Corps of Engineers 3/9/01

Table 8. Summary of cover-types and their acreage which would be inundated at Folsom Reservoir at full flood pool if Folsom Dam were raised 3.5, 8.5, or 12-feet as part of the American River Watershed Investigation, California.

PROJECT FEATURE	COVER-TYPE	ACREAGE		
		3.5-foot raise 478 Pool	8.5-foot raise 482 Pool	12-foot raise 487 Pool
Folsom Reservoir (operations)	Blue oak - gray pine	283.7 (784)	367.3 (1,015)	469.7 (1,298)
	Oak woodland	205.2 (570)	264.2 (733)	350.0 (927)
	Chaparral	20.1 (20)[1]	28.7 (29)	38.7 (39)
	Annual grassland	80.5 replant	106.5 replant	172.7 replant
	SUBTOTAL	589.5 (1,374)	766.7 (1,777)	1,031.1 (2,264)

1. This ratio assumes a 1:1 replacement as the HEP was not completed for this cover-type.

Assuming a worst case scenario that over the life of the project all of the existing vegetation (except riparian and seasonal wetlands) in the inundation zone would be lost, a compensation need was developed for each cover-type using the HEP results. These numbers (rounded to whole acre) appear in parentheses next to the acreage impacted in Table 8. Statistically, there is a relatively small chance of complete inundation coupled with total loss of vegetation. However, it is reasonable to expect some impacts, especially at the lower zones due to the potential for more frequent inundation, over the life of the project.

Given the uncertainties on effects of inundation on vegetation and soil erosion, the HEP Team decided to recommend that a monitoring and adaptive management program be developed to monitor vegetation around the reservoir over the life of the project. Baseline conditions would be managed and updated at intervals (10 years). After major flood events (those which encroach above the existing maximum flood pool elevation), vegetation would be surveyed and damages attributable to inundation would be mitigated as deemed appropriate using best management practices at the time (replanting on site would be the first priority).

Lastly, preliminary work conducted by the Corps indicates that one or more bridges or culvert crossings and/or their approaches may be inundated for short periods of time along Salmon Falls Road to accommodate the maximum flood pool with the 12-foot dam raise (pool elevation 487). No impacts to fish and wildlife resources were identified for this potential short duration flooding.

HEP APPENDIX A-1

DATA ANALYSIS ASSUMPTIONS

PA 1 - Future Without Project (Impact Area)

OAK WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured)

	V1 - % canopy closure of trees and shrubs that produce hard mast (58%)	SI = 1.0
	V2 - Density of leaf litter layer (Low)	SI = 0.2
	V3 - % tree cover (53%)	SI = 1.0
	V4 - Den site availability (24/ac)	SI = 1.0

HSI Food $= (V1 \times V2)^{1/2} = (1.0 \times 0.2)^{1/2} = 0.45$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (1.0 \times 1.0)^{1/2} = 1.0$

HSI = 0.45 (lowest of values)

TY 1	V1 - no change from TY 0	SI = 1.0
	V2 - no change from TY 0	SI = 0.2
	V3 - no change from TY 0	SI = 1.0
	V4 - no change from TY 0	SI = 1.0

HSI = 0.45

TY 106	V1 $\geq$ 50%	SI = 1.0
	V2 low	SI = 0.2
	V3 $\geq$ 50%	SI = 1.0
	V4 $\geq$ 4 / acre	SI = 1.0

PLAIN TITMOUSE

TY 0 - Baseline (measured)

	V1 - dbh (7.6")	SI = 0.6
	V2 - Number trees/acre (263)	SI = 1.0
	V3 - % trees that are oaks (91%)	SI = 1.0

$$HSI = \frac{V1 + V2 + V3}{3}$$

$$= \frac{0.6 + 1.0 + 1.0}{3}$$

$$= .87$$

TY 1	V1 - no change from TY 0	SI = 0.6
	V2 - no change from TY 0	SI = 1.0
	V3 - no change from TY 0	SI = 1.0

HSI = .87

TY 106	V1 - no change from TY 0	SI = 0.6
	V2 - at least $\geq$ 60 trees/ac	SI = 1.0
	V3 - no change from TY 0	SI = 1.0

HSI = .87

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) HSI = 0.45

TY 1 -

V1 - no trees	SI = 0
V2 - low leaf litter	SI = 0.2
V3 - no trees	SI = 0
V4 - no den sites	SI = 0

HSI Food $= (V1 \times V2)^{½}$
$= (0 \times 0.2)^{½}$
$= 0$

HSI Cover/Reproduction $= (V3 \times V4)^{½}$
$= (0 \times 0)^{½}$
$= 0$

HSI = 0

TY 106 -

V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) HSI = 0.87

TY 1 -

V1 - no trees	SI = 0.2
V2 - no trees	SI = 0
V3 - no trees	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2}{3} = 0.07$$

TY 106 -

V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .07

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to oak woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees)	SI = 0
V2 - Density of leaf litter (low)	SI = 0.2
V3 - Den site availability (no trees)	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 16 - no change from TY 1 HSI = 0

TY 30 - no change from TY 16 HSI = 0

TY 106 - no change from TY 30 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0)	SI = 0.2
V2 - Number trees/acre (0)	SI = 0
V3 - % trees that are oaks (0)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .07$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .07

TY 16 - no change from TY 1 HSI = .07

TY 30 - no change from TY 16 HSI = .07

TY 106 - no change from TY 30 HSI = .07

MP 2 - Management Area - Future With Project (Compensation Site)

Assume: 1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1 , provide access and maintenance roads
3. Plant 100% blue and live oak trees (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 106 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -	V1 - tree species planted /no mast	SI = 0
	V2 - low	SI = 0.2
	V3 - 0 (no trees)	SI = 0
	V4 - 0 (no trees)	SI = 0

HSI = 0

TY 16 -	V1 - oak trees reach 16ft. high 8%	SI = 0.15
	V2 - low	SI = 0.2
	V3 - 8%	SI = 0.15
	V4 - 0	SI = 0

HSI Food = $(V1 \times V2)^{1/2}$ = $(0.15 \times 0.2)^{1/2}$ = .17

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$ = $(0.15 \times 0)^{1/2}$ = 0

HSI = 0

TY 30	V1 - 13%	SI = 0.28
	V2 - low	SI = 0.2
	V3 - 53%	SI = 0.28
	V4 - 0	SI = 0

HSI Food = $(V1 \times V2)^{1/2}$ = $(.28 \times 0.2)^{1/2}$ = 0.24

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$ = $(0.28 \times 0)^{1/2}$ = 0

HSI = 0

TY 106	V1 - 58%	SI = 1.0
	V2 - low	SI = 0.2
	V3 - 53%	SI = 1.0
	V4 - 24/ac	SI = 1.0

HSI Food = $(V1 \times V2)^{1/2}$ = $(1.0 \times 0.2)^{1/2}$ = 0.45

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$ = $(1.0 \times 1.0)^{1/2}$ = 1.6

HSI = 0.45

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

HSI = .07

TY 1 -	V1 - tree species planted (oak) (0 dbh)	SI = 0.2

	V2 - 400 (100% $\leq$ 16 ft tall; no trees)	SI = 0
	V3 - 100% (no trees)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .07$$

TY 16 -	V1 - oak trees reach 16 ft. high (dbh = 1.75)	SI = 0.2
	V2 - $\geq$ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

TY 30 -	V1 - 2.5 dbh	SI = 0.2
	V2 - $\geq$ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

TY 106-	V1 - dbh 8.0	SI = 0.6
	V2 - $\geq$ 100 trees/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.6 + 1.0 + 1.0}{3} = \frac{2.6}{3} = 0.87$$

PA 1 - Future Without the Project (Impact Area)

SEASONAL WETLAND

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation (12 in)	SI = 1.0
V2 - % cover of herbaceous vegetation (100%)	SI = 1.0
V3 - Soil type (mod. friable)	SI = 0.5

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 1.0 + 0.5}{3} = .83$$

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .83

TY 106
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .83

GREAT EGRET (feeding)

TY 0 - Baseline (estimated)

V1 - % of area with water 4-9 inches deep (5%)	SI = 0.5
V2 - % of area 4-9 inches deep with emergent / submergent vegetation (100%)	SI = 0

$$HSI = \frac{V1 + V2}{2} = \frac{0.05 + 0}{2} = .03$$

TY 1
V1 - no change from TY 0
V2 - no change from TY 0

HSI = .03

TY 106
V1 - no change from TY 1
V2 - no change from TY 1

HSI = .03

TY 0 - Baseline (estimated)

V1 - Emergent vegetation is old/new growth	SI = 1.0
V2 - Water present throughout year	SI = 1.0
V3 - Carp absent	SI = 0.1
V4 - larvae of dragonflies & damselflies present	SI = 1.0
V5 - herbaceous vegetation is dense	SI = 0.3
V6 - Condition A wetland	SI = 0.9

HSI = $(V1 + V2 + V3 + V4 + V5)^{½}$ = 1.0 x 1.0 x 0.1 x 1.0 x 0.3
= .17

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0
V5 - no change from TY 0
V6 - no change from TY 0

HSI = .17

TY 106
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1
V5 - no change from TY 1
V6 - no change from TY 1

HSI = .17

PA 2 - Future With Project (Impact Area)

Assumptions:
1. All vegetation removed from construction areas in TY 1
2. No woody vegetation allowed in permanent and temporary easement areas.
3. Wetland area converted to annual grassland

CALIFORNIA VOLE

TY 0 - Baseline (estimated) HSI = 0.51

TY 1 -	V1 - Height of herbaceous vegetation (0)	SI = 0
	V2 - % cover of herbaceous vegetation (0)	SI = 0
	V3 - soil type (mod friable)	SI = 0.5

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.5}{3} = .17$$

TY 8 -	V1 - $\geq$ 6 in	SI = 1.0
	V2 - 100%	SI = 1.0
	V3 - no change	SI = 0.5

$$HSI = \frac{1.0 + 1.0 + 0.5}{3} = .83$$

TY 106 -
V1 - no change from TY 8
V2 - no change from TY 8
V3 - no change from TY 8

HSI = .83

GREAT EGRET

TY 0 - Baseline (measured)

HSI = .03

TY 1	V1 - % of area with water 4-9 inches deep (0)	SI = 0
	V2 - % of submergent/emergent vegetation in zone 4-9 inches deep (0)	SI = 0.1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 8
V1 - no change from TY 1
V2 - no change from TY 1

HSI = .05

TY 106
V1 - no change from TY 8
V2 - no change from TY 8

HSI = .05

TY 0 - Baseline (estimated) HSI = .17

TY 1 -	V1 - Emergent vegetation is old/new growth monocot (other)	SI = 0.1
	V2 - Water present throughout year (dry)	SI = 0.1
	V3 - Carp presence (absent)	SI = 1.0
	V4 - larvae of dragonflies/damselflies presence (absent)	SI = 0.1
	V5 - vegetation density (upland only)	SI = 0.1

HSI = $(V1 + V2 + V3 + V4 + V5)^{½}$ = $(0.1 \times 0.1 \times 1.0 \times 0.1 \times 0.1)^{½}$ = 0.1 but
(area is now a condition C wetland; therefore HSI = V7 x V8 = 0)

TY 8 -
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1
V5 - no change from TY 1
V6 - no change from TY 1

HSI = 0

TY 106 -
V1 - no change from TY 8
V2 - no change from TY 8
V3 - no change from TY 8
V4 - no change from TY 8
V5 - no change from TY 8
V6 - no change from TY 8

HSI = 0

MP 1 - Future Without Project (Compensation Area)

Assumption: 1. Annual grassland area will be converted to wetlands

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

	V1 - Height of herbaceous vegetation ($\geq$ 6in.)	SI = 1.0
	V2 - % cover of herbaceous vegetation (80%)	SI = 6.7
	V3 - soil type (mod. friable)	SI = 0.5

TY 1 - V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 4 - V1 - no change from TY 1

TY 106 - V1 - no change from TY 4

GREAT EGRET

TY 0 - Baseline (measured)

	V1 - % of area with water 4-9 inches deep (0)	SI = 0
	V2 - % of area 4-9 deep with emergent/submergent vegetation (0)	SI = .1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 no change from TY 0

TY 8 no change from TY 1

TY 106 no change from TY 4

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for species HSI = 0

TY 1 - no change from TY 0

TY 4 - no change from TY 1

TY 106 -no change from TY 4

MP 2 - Future With Project (Compensation Site)

Assumption:

1. Acquire annual grassland area
2. Portion of wetland area will have permanent water
3. Wetland will be designed to provide equal mix of open water and emergent vegetation
4. Carp will not be stocked
5. Site baseline is a Condition C wetland.
6. Site is minimum of 1-acre in size and access and maintenance roads are provided.
7. 40% of area designed for summer conditions of water 4-9 in deep
8. Plant appropriate wetland plant species, provide pest control and maintenance as needed for minimum of 3 years or until wetland is established.
9. Cover crop planted on all disturbed non-wetland areas.

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation ($\geq$ 6 in.)	SI = 1.0
V2 - % cover of herbaceous vegetation (80%)	SI = 0.7
V3 - soil type (mod friable)	SI = 0.5

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 1 -

V1 - $\geq$ 6 in	SI = 1.0
V2 - 90%	SI = 0.85
V3 - no change fro baseline	SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 4 -

V1 - no change from TY 1	SI = 1.0
V2 - 100%	SI = 0
V3 - no change from TY 1	SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 106

V1 - no change from TY 4
V2 - no change from TY 4
V3 - no change from TY 4

HSI = .50

GREAT EGRET

TY 0 - Baseline (estimated)

V1 - % of area with water 4-9 inches deep (0)	SI = 0
V2 - % of area with water 4-9 deep with emergent/submergent vegetation	SI = 0.1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 -

V1 - 40%	SI = 0.4
V2 - 5%	SI = 0.2

$$HSI = \frac{0.4 + 0.2}{2} = \frac{0.6}{2} = .30$$

TY 4 -

V1 - 40%	SI = 0.4

V2 - 40% - 60% SI = 1.0

$$HSI = \frac{0.4 + 1.0}{2} = .70$$

TY 106 - no change from TY 4

HSI = .70

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for species HSI = 0

TY 1 -	V1 - Emergent vegetation is old/new growth monocot (other)	SI = 0.1
	V2 - Water present throughout year (yes)	SI = 1.0
	V3 - Carp presence (absent)	SI = 1.0
	V4 - larvae of dragonflies/damselflies presence (yes)	SI = 1.0
	V5 - vegetation density (sparse first year)	SI = 0.1

$HSI = (V1 + V2 + V3 + V4 + V5)^{½} = (0.1 \times 1.0 \times 1.0 \times 1.0 \times 0.1)^{½} = 0.1$

TY 4 -	V1 - old/new growth monocots	SI = 1.0
	V2 - no change	SI = 1.0
	V3 - no change	SI = 1.0
	V4 - no change	SI = 1.0
	V5 - 50%	SI = 1.0

$HSI = (1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0)^{½} = 1.0$

TY 106 - no change from TY 4

HSI = 1.0

PA 1 - Future Without Project (Impact Area)

RIPARIAN

GREAT HORNED OWL

TY 0 - Baseline (measured)

V1 - % herbaceous canopy cover	SI = 1.0
V2 - % herbaceous cover 6-36inches tall (87%)	SI = 1.0
V4 - % shrub crown cover (33%)	SI = 1.0
V6 - Forest overstory size (7.0 dbh)	SI = 0.4
V7 - Size of forested area (~1.0 ac)	SI = .05

Cover/Reproductive Value HSI $= (V6 \times V7^2)^{1/3}$
$= (0.4 \times 0.5^2)^{1/3}$
$= 0.27$

Food Value HSI $= (V1 \times V2 \times V4)^{1/3}$
$= (1.0 \times 1.0 \times 1.0)^{1/3}$
$= 1.0$

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V4 - no change from TY 0
V6 - no change from TY 0
V7 - no change from TY 0

HSI = 0.27

TY 106

V1 - no change from TY 1	SI = 1.0
V2 - no change from TY 1	SI = 1.0
V4 - no change from TY 1	SI = 1.0
V6 - no change from TY 1	SI = 0.4
V7 - no change from TY 1	SI = .05

HSI = 0.27

PA 2 - Future With Project (Impact Area)

GREAT HORNED OWL

Assumptions: 1. All vegetation removed from impact area in TY 1
2. No woody vegetation allowed in permanent or temporary easement areas

TY 0 - Baseline (measured) HSI = .27

TY 1	V1 - 0%	SI = 0
	V2 - 0%	SI = 0
	V4 - 0%	SI = 0
	V6 - A	SI = 0.1
	V7 - 0	SI = 0

Cover/ Reproduction Value HSI $= (V6 \times V7)^{1/3}$
$= (0.1 \times 0)^{1/3}$
$= 0$

Food Value HSI $= (V1 \times V2 \times V4)^{1/3}$
$= (0 \times 0 \times 0)^{1/3}$
$= 0$

TY 107 - no change from TY 1 HSI = 0

MP 1 - Future Without Project (Compensation Area)

Assumption: 1. Annual grassland area will be converted to mixed riparian

TY 0 - Baseline (estimated)

V1 - % herbaceous canopy cover ($\geq$ 50%)	SI = 1.0
V2 - % cover of herbaceous vegetation (80%)	SI = 1.0
V4 - % shrub crown cover (0)	SI = 0
V5 - Forest overstory size	SI = 0.1
V6 - Size of forested area (10 ac)	SI = 0

Food Value HSI $= (V1 \times V2 \times V4)^{1/3}$
$= (0.1 \times 0)^{1/3}$
$= 0$

Cover/Reproductive HSI $= (V6 \times V7)^{1/3}$
$= (0.1 \times 0)^{1/3}$
$= 0$

TY 1 - no change from TY 0 HSI = 0

TY 10 - no change from TY 1 HSI = 0

TY 106 - no change from TY HSI = 0

MP 2 - Future With Project (Compensation Site)

Assumption:
1. Acquire land and provide access and maintenance roads
2. Oaks, willows, cottonwood trees (200/acres total) planted for overstory; wild grape and wild rose planted for understory (200/acre total) Tree species are stock from 4"x4"x14" tree pots.
3. Plants cover crop on entire site.
4. Maintenance of site for minimum of 3 yrs (weed control, watering, predation controlled) and take remedial action to ensure plant establishment..
5. Assume 10 ac site
6. Site cleared in year 1
7. TY 10 trees reach at least 16 feet tall (average)

TY 0 - Baseline (estimated) HSI = 0

TY 1 -

V1 - $\geq$ 50% after planting	SI = 1.0
V2 - $\geq$ 50% after planting	SI = 1.0
V4 - 5% from new plantings	SI = 0.3
V6 - A	SI = 0.1
V7 - 10 acres (trees not 16')	SI = 0

Cover/Reproductive Value HSI $= (V6 \times V7)^{1/3}$
$= (0.1 \times 0)^{1/3}$
$= 0$

Food Value HSI $= (V1 \times V2 \times V4)^{1/3}$
$= (1.0 \times 1.0 \times 0.3)^{1/3}$
$= (0.3)^{1/3}$
$= .67$

HSI = 0

TY 10 -	V1 - $\geq$ 50%	SI = 1.0
	V2 - $\geq$ 50%	SI = 1.0
	V4 - 25%	SI = 1.0
	V6 - A	SI = 0.1
	V7 - 10 acres	SI = 0.6

Cover/Reproduction Value HSI $= (V6 \times V7)^{1/3}$
$= (0.1 \times 0.6)^{1/3}$
$= .39$

Food Value HSI $= (V1 \times V2 \times V4)^{1/3}$
$= (1.0 \times 1.0 \times 1.0)^{1/3}$
$= 1.0$

HSI = .39

TY 106	V1 - $\geq$ 50%	SI = 1.0
	V2 - $\geq$ 50%	SI = 1.0
	V4 - 50%	SI = 1.0
	V6 - C	SI = 0.6
	V7 - 10 acres	SI = 0.6

Cover/Reproduction Value HSI $= (V6 \times V7)^{1/3}$
$= (0.1 \times 0.6)^{1/3}$
$= (.39)^{1/3}$
$= .71$

Food Value HSI $= (V1 \times V2 \times V4)^{1/3}$
$= (1.0 \times 1.0 \times 1.0)^{1/3}$
$= 1.0$

PA 1 - Future Without Project (Impact Area)

BLUE OAK-GRAY PINE WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured)

	V1 - % canopy closure of trees and shrubs that produce hard mast (70 %)	SI = 1.0
	V2 - Density of leaf litter layer (Low)	SI = 0.2
	V3 - % tree cover (70%)	SI = 1.0
	V4 - Den site availability (43/ac)	SI = 1.0

HSI Food $= (V1 \times V2)^{1/2}$
$= (1.0 \times 0.2)^{1/2}$
$= 0.45$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (1.0 \times 1.0)^{1/2}$
$= 1.0$

HSI = 0.45 (lowest of values)

TY 1	V1 - no change from TY 0	SI = 1.0
	V2 - no change from TY 0	SI = 0.2
	V3 - no change from TY 0	SI = 1.0
	V4 - no change from TY 0	SI = 1.0

HSI = 0.45

TY 106	V1 $\geq$ 50%	SI = 1.0
	V2 low	SI = 0.2
	V3 $\geq$ 50%	SI = 1.0
	V4 $\geq$ 4 / acre	SI = 1.0

PLAIN TITMOUSE

TY 0 - Baseline (measured)

	V1 - dbh (11.2")	SI = 0.6
	V2 - Number trees/acre (257)	SI = 1.0
	V3 - % trees that are oaks (83%)	SI = 1.0

$$HSI = \frac{V1 + V2 + V3}{3}$$

$$= \frac{0.6 + 1.0 + 1.0}{3}$$

HSI = .87

TY 1	V1 - no change from TY 0	SI = 0.6
	V2 - no change from TY 0	SI = 1.0
	V3 - no change from TY 0	SI = 1.0

HSI = .87

TY 106	V1 - no change from TY 0	SI = 0.6
	V2 - at least $\geq$ 60 trees/ac	SI = 1.0
	V3 - no change from TY 0	SI = 1.0

HSI = .87

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) HSI = 0.45

TY 1 -

V1 - no trees		SI = 0
V2 - low leaf litter		SI = 0.2
V3 - no trees		SI = 0
V4 - no den sites		SI = 0

HSI Food $= (V1 \times V2)^{1/2}$
$= (0 \times 0.2)^{1/2}$
$= 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (0 \times 0)^{1/2}$
$= 0$

HSI = 0

TY 106 -
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) HSI = 0.87

TY 1 -

V1 - no trees		SI = 0.2
V2 - no trees		SI = 0
V3 - no trees		SI = 0

$$\frac{V1 + V2 = V3}{3} = \frac{0.2}{3}$$

HSI = 0.07

TY 106 -
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .07

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to blue oak-gray pine woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees)	SI = 0
V2 - Density of leaf litter (low)	SI = 0.2
V3 - Den site availability (no trees)	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 16 - no change from TY 1 HSI = 0

TY 30 - no change from TY 16 HSI = 0

TY 106 - no change from TY 30 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0)	SI = 0.2
V2 - Number trees/acre (0)	SI = 0
V3 - % trees that are oaks (0)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .07$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .07

TY 16 - no change from TY 1 HSI = .07

TY 30 - no change from TY 16 HSI = .07

TY 106 - no change from TY 30 HSI = .07

MP 2 - Management Area - Future With Project (Compensation Site)

Assume: 1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1, provide access and maintenance roads
3. Plant 90% blue and live oak trees and 10% gray pine (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 106 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -	V1 - tree species planted /no mast	SI = 0
	V2 - low	SI = 0.2
	V3 - 0 (no trees)	SI = 0
	V4 - 0 (no trees)	SI = 0

HSI = 0

TY 16 -	V1 - trees reach 16ft. high 8%	SI = 0.15
	V2 - low	SI = 0.2
	V3 - 8%	SI = 0.15
	V4 - 0	SI = 0

HSI Food = $(V1 \times V2)^{1/2}$
= $(0.15 \times 0.2)^{1/2}$
= .17

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(0.15 \times 0)^{1/2}$
= 0

HSI = 0

TY 30	V1 - 13%	SI = 0.28
	V2 - low	SI = 0.2
	V3 - 53%	SI = 0.28
	V4 - 0	SI = 0

HSI Food = $(V1 \times V2)^{1/2}$
= $(.28 \times 0.2)^{1/2}$
= 0.24

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(0.28 \times 0)^{1/2}$
= 0

HSI = 0

TY 106	V1 - 58%	SI = 1.0
	V2 - low	SI = 0.2
	V3 - 53%	SI = 1.0
	V4 - 24/ac	SI = 1.0

HSI Food = $(V1 \times V2)^{1/2}$
= $(1.0 \times 0.2)^{1/2}$
= 0.45

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(1.0 \times 1.0)^{1/2}$
= 1.6

HSI = 0.45

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

HSI = .07

TY 1 -	V1 - tree species planted (oak/gray pine) (0 dbh)	SI = 0.2
	V2 - 400 (100% $\leq$ 16 ft tall; no trees)	SI = 0
	V3 - 100% (no trees)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .07$$

TY 16 -	V1 - trees reach 16 ft. high (dbh = 1.75")	SI = 0.2
	V2 - $\geq$ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

TY 30 -	V1 - 2.5 dbh	SI = 0.2
	V2 - $\geq$ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

TY 106 -	V1 - dbh 8.0	SI = 0.6
	V2 - $\geq$ 100 trees/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.6 + 1.0 + 1.0}{3} = \frac{2.6}{3} = 0.87$$

APPENDIX B

AMERICAN RIVER WATERSHED INVESTIGATION
LONG-TERM STUDY

FOLSOM DAM ENLARGEMENT PLAN

L.L. ANDERSON DAM MODIFICATIONS
(FRENCH MEADOWS RESERVOIR)

AUGUST 2001

FRENCH MEADOWS RESERVOIR

BACKGROUND

L.L. Anderson Dam (French Meadows Reservoir) is owned by Placer County Water Agency and is located on the Middle Fork of the American River above Folsom Dam. The Corps of Engineers (Corps) has determined that the embankment dam has inadequate spillway capacity and would overtop and fail during a probable maximum flood event. This failure would add about 250,000 cubic feet per second (cfs) of flow to the probable maximum flood at Folsom Dam. Providing passage for this additional flow at Folsom dam would cost considerably more than modifying L.L. Anderson Dam and spillway for safe passage of the probable maximum flood.

The dam is currently fitted with parapet walls ranging in height from 1 to 3 feet along the left and right sides of the dam crest. The wind setup and wave runup for the project is 3.6 feet. The spillway consists of an ogee crest at elevation 5,244.5 feet which discharges to a 50-foot-wide rock-lined exit channel. The spillway crest is gated with two tainter gates 20 feet wide by 18.5 feet high. About 300 feet downstream of the spillway, the exit channel drops 44 feet into an escape channel at a right angle to the exit channel. The escape channel is about 1,000 feet long and varies in bottom width from 25 feet at the upstream end to 50 feet at the downstream end. Downstream of the escape channel there is an additional 800 feet of channel work before the spillway flows return to the Middle Fork of the American River.

PROJECT DESCRIPTION

The following modifications are proposed for L.L. Anderson Dam so that it can pass the probable maximum flood.:

- The existing two-tainter-gate ogee crest control structure would be removed.
- A new three-tainter-gate (27 feet wide by 18.5 feet high) ogee crest control structure would be constructed at the entrance to the spillway channel.
- The existing rock excavated spillway channel would be deepened (about 23 feet) and extended (about 100 feet) to connect to the new control structure as a side-channel spillway.
- The existing downstream spillway escape channel would be widened at a constriction point (rock outcrop).
- The existing parapet crest wall would be raised and extended (3.6-foot high maximum height,1,200-foot raise, 1,400 foot extension) to provide adequate freeboard during the probable maximum flood event. The material excavated would most likely be stored at the staging area used during construction of the dam or at the downstream end of the spillway.

Widening and deepening of the spillway channel would accomplished through blasting. Holes would be drilled in bedrock, loaded with explosives, blasted, then “mucked” by removal of the shot rock to a designated spoil area just downstream of the dam. The blasting and mucking would occur on an anticipated cycle of one to two days throughout the construction period (May to October).

Access to the lower portion of the escape channel where the rock outcrop would be removed would be accomplished by utilizing an existing road and extending the old road alignment used to access the area for repairs completed in 1998. An earthen crossing would be constructed across the Middle Fork of the American River and river flow would be diverted around the crossing via pipeline. The diversion would be constructed by installing a rock and earth coffer dam upstream of the proposed crossing. Water would be pumped from the created pool around the dewatered area and the slopes of the coffer dam would be shotcreted to stabilize the bank. A pipe would be inserted into the coffer dam and secured around the dewatered area to create a gravity flow diversion. The structure would be removed after construction is complete and the road extension returned to its pre-project condition.

IMPACT ANALYSIS

The HEP Team which performed the impact analysis for the Folsom Reservoir impacts did not have sufficient project information at that time to conduct a similar analysis for French Meadows Reservoir. In June 2001, Corps of Engineers (Corps), Fish and Wildlife Service (Service), Placer County Water Agency, and Corps contractor staff conducted a site review of the proposed project.

The project area encompasses about 1.4 acres and an access road and extension to the spillway escape channel. The area is composed of about 0.24 acres of Sierran mixed conifer forest, 1.1 acres of bedrock excavated spillway (which contains a few small scattered willow species) and about 0.4 acres of constriction removal (knob) from the escape channel.

Due to the small impact area and overall little impact to vegetation (compared to the overall amount of habitat in the area), HEP was not proposed for this portion of the work. Specific mitigation measures were identified however, and included:

<u>General</u>

- Ensure materials such as fuels, hydraulic oils and lubricants, cement products, etc. are stored in a manner so that their introduction into water bodies and soils is minimized.

<u>Spillway enlargement</u>

- Avoid impacts to the Sierran mixed conifer habitat to the extent possible.
- Avoid impacts to swallow nesting (cliff and/or barn swallows) on the bridge crossing of the French Meadows spillway by removing old nests prior to March 1 and placing netting material so that they cannot construct new nests during the construction period.
- Minimize impacts by reseeding all disturbed soil areas with annual grasses after construction is complete (most of the area appears to be underlain with bedrock).
- Minimize impact to aquatic resources by taking appropriate steps to prevent sediment from entering the reservoir or river.

- Minimize impacts to nesting raptors by conducting this activity outside the breeding period, or determining there are no raptor nests in the vicinity prior to construction.

Escape channel constriction removal

- Avoid impacts to vegetation by confining all work activities to existing roads and already disturbed areas.
- Minimize impacts of river crossing by constructing it in a manner which disturbs the natural channel and streambed the least extent.
- Minimize impacts to disturbed soil areas by reseeding such areas with annual grass species when construction is complete.
- Minimize impacts to the river by constructing sediment barriers to prevent sediments from washing into the river during construction.

Spoil area

- Avoid placement of spoil material on vegetated areas.
- Minimize potential impacts to the river by constructing sediment barriers to prevent sediments from washing into the river after construction is complete.

APPENDIX C

AMERICAN RIVER WATERSHED INVESTIGATION
FOLSOM DAM ENLARGEMENT PLAN

ENDANGERED SPECIES CONSULTATION

Federal Endangered and Threatened Species that may be affected by projects in El Dorado County

Database Last Updated: April 30, 2001
Today's Date is: July 31, 2001

Listed Species
Branchinecta lynchi - vernal pool fairy shrimp (T)

Calystegia stebbinsii - Stebbins' morning-glory (E)

Ceanothus roderickii - Pine Hill ceanothus (E)

Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)

Fremontodendron californicum ssp. decumbens - Pine Hill flannelbush (E)

Galium californicum ssp. sierrae - El Dorado bedstraw (E)

Haliaeetus leucocephalus - bald eagle (T)

Hypomesus transpacificus - delta smelt (T)

Lepidurus packardi - vernal pool tadpole shrimp (E)

Oncorhynchus (=Salmo) clarki henshawi - Lahontan cutthroat trout (T)

Oncorhynchus mykiss - Central Valley steelhead (T)

Oncorhynchus tshawytscha - winter-run chinook salmon (E)

Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)

Oncorhynchus tshawytscha - Critical Habitat, Central Valley spring-run chinook (T)

Orcuttia viscida - Sacramento Orcutt grass (E)

Pogonichthys macrolepidotus - Sacramento splittail (T)

Rana aurora draytonii - California red-legged frog (T)

Rana aurora draytonii - Critical habitat, California red-legged frog (T)

Senecio layneae - Layne's butterweed (T)

Thamnophis gigas - giant garter snake (T)

Proposed Species
Charadrius montanus - mountain plover (PT)

Candidate Species
Ambystoma californiense - California tiger salamander (C)

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)

Rorippa subumbellata - Tahoe yellow-cress (C)

Species of Concern

Accipiter gentilis - northern goshawk (SC)

Acipenser medirostris - green sturgeon (SC)

Agelaius tricolor - tricolored blackbird (SC)

Amphispiza belli belli - Bell's sage sparrow (SC)

Arctostaphylos nissenana - Nissenan manzanita (SC)

Athene cunicularia hypugea - western burrowing owl (SC)

Atriplex joaquiniana - valley spearscale (SC)

Branta canadensis leucopareia - Aleutian Canada goose (D)

Bufo canorus - Yosemite toad (SC)

Buteo regalis - ferruginous hawk (SC)

Buteo Swainsoni - Swainson's hawk (CA)

Calochortus clavatus var. avius - Pleasant Valley mariposa (SC)

Capnia lacustra - Lake Tahoe benthic stonefly (SC)

Chlorogalum grandiflorum - Red Hills soaproot (SC)

Clemmys marmorata marmorata - northwestern pond turtle (SC)

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)

Cypripedium fasciculatum - clustered lady's-slipper (SC)

Draba asterophora var. macrocarpa - Cup Lake draba (SC)

Empidonax traillii brewsteri - little willow flycatcher (CA)

Epilobium oreganum - Oregon fireweed (SC)

Euderma maculatum - spotted bat (SC)

Eumops perotis californicus - greater western mastiff-bat (SC)

Falco peregrinus anatum - American peregrine falcon (D)

Goeracea oregona - Sagehen Creek goracean caddisfly (SC)

Gulo gulo luteus - California wolverine (CA)

Horkelia parryi - Parry's horkelia (SC)

Hydromantes platycephalus - Mount Lyell salamander (SC)

Lepus americanus tahoensis - Sierra Nevada snowshoe hare (SC)

Lewisia longipetala - long-petaled lewisia (SC)

Lewisia serrata - saw-toothed lewisia (SC)

Linderiella occidentalis - California linderiella fairy shrimp (SC)

Martes americana - American (=pine) marten (SC)

Martes pennanti pacifica - Pacific fisher (SC)

Megaleuctra sierra - Shirttail Creek stonefly (SC)

Monadenia mormonum buttoni - Button's Sierra sideband snail (SC)

Myotis ciliolabrum - small-footed myotis bat (SC)

Myotis evotis - long-eared myotis bat (SC)

Myotis thysanodes - fringed myotis bat (SC)

Myotis volans - long-legged myotis bat (SC)

Myotis yumanensis - Yuma myotis bat (SC)

Nebria darlingtoni - South Forks ground beetle (SC)

Orbittacus obscurus - gold rush hanging fly (SC)

Perognathus inornatus - San Joaquin pocket mouse (SC)

Phacelia stebbinsii - Stebbins' phacelia (SC)

Phrynosoma coronatum frontale - California horned lizard (SC)

Plegadis chihi - white-faced ibis (SC)

Rana boylii - foothill yellow-legged frog (SC)

Rana muscosa - mountain yellow-legged frog (SC)

Rhyacophila spinata - spiny rhyacophilan caddisfly (SC)

Riparia riparia - bank swallow (CA)

Scaphiopus hammondii - western spadefoot toad (SC)

Sceloporus graciosus graciosus - northern sagebrush lizard (SC)

Spirinchus thaleichthys - longfin smelt (SC)

Strix occidentalis occidentalis - California spotted owl (SC)

Vulpes vulpes necator - Sierra Nevada red fox (CA)

Wyethia reticulata - El Dorado mule-ears (SC)

Key:

(E) Endangered - Listed (in the Federal Register) as being in danger of extinction.

(T) Threatened - Listed as likely to become endangered within the foreseeable future.

(P) Proposed - Officially proposed (in the Federal Register) for listing as endangered or threatened.

(C) Candidate - Candidate to become a proposed species.

(D) Delisted - Species will be monitored for 5 years.

(SC) Species of Concern - Other species of concern to the Sacramento Fish & Wildlife Office.

Critical Habitat - Area essential to the conservation of a species.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

This is *not* an official list for formal consultation under the Endangered Species Act. *However, it may be used to update official lists.*

If you have a project that may affect endangered species, please contact the Endangered Species Division, Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service.

Federal Endangered and Threatened Species that may be affected by projects in Placer County

Database Last Updated: April 30, 2001
Today's Date is: July 31, 2001

Listed Species
Berberis sonnei - Truckee barberry (E)

Branchinecta lynchi - vernal pool fairy shrimp (T)

Calystegia stebbinsii - Stebbins' morning-glory (E)

Ceanothus roderickii - Pine Hill ceanothus (E)

Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)

Galium californicum ssp. sierrae - El Dorado bedstraw (E)

Haliaeetus leucocephalus - bald eagle (T)

Hypomesus transpacificus - delta smelt (T)

Lepidurus packardi - vernal pool tadpole shrimp (E)

Oncorhynchus (=Salmo) clarki henshawi - Lahontan cutthroat trout (T)

Oncorhynchus mykiss - Central Valley steelhead (T)

Oncorhynchus tshawytscha - winter-run chinook salmon (E)

Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)

Oncorhynchus tshawytscha - Critical Habitat, Central Valley spring-run chinook (T)

Orcuttia viscida - Sacramento Orcutt grass (E)

Pogonichthys macrolepidotus - Sacramento splittail (T)

Rana aurora draytonii - Critical habitat, California red-legged frog (T)

Senecio layneae - Layne's butterweed (T)

Thamnophis gigas - giant garter snake (T)

Proposed Species
Charadrius montanus - mountain plover (PT)

Candidate Species
Ambystoma californiense - California tiger salamander (C)

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)

Rorippa subumbellata - Tahoe yellow-cress (C)

Species of Concern

Accipiter gentilis - northern goshawk (SC)

Acipenser medirostris - green sturgeon (SC)

Agelaius tricolor - tricolored blackbird (SC)

Arabis rigidissima var. demota - Carson Range rock-cress (SC)

Arctostaphylos nissenana - Nissenan manzanita (SC)

Athene cunicularia hypugea - western burrowing owl (SC)

Branta canadensis leucopareia - Aleutian Canada goose (D)

Buteo regalis - ferruginous hawk (SC)

Capnia lacustra - Lake Tahoe benthic stonefly (SC)

Chlorogalum grandiflorum - Red Hills soaproot (SC)

Clemmys marmorata marmorata - northwestern pond turtle (SC)

Cordylanthus mollis ssp. hispidus - hispid bird's-beak (SC)

Corynorhinus (=Plecotus) townsendii pallescens - pale Townsend's big-eared bat (SC)

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)

Dipodomys californicus eximius - Marysville Heermann's kangaroo rat (SC)

Empidonax traillii brewsteri - little willow flycatcher (CA)

Eriogonum umbellatum var. torreyanum - Donner Pass buckwheat (SC)

Euderma maculatum - spotted bat (SC)

Eumops perotis californicus - greater western mastiff-bat (SC)

Falco peregrinus anatum - American peregrine falcon (D)

Goeracea oregona - Sagehen Creek goracean caddisfly (SC)

Grus canadensis tabida - greater sandhill crane (CA)

Gulo gulo luteus - California wolverine (CA)

Hydromantes platycephalus - Mount Lyell salamander (SC)

Ivesia sericoleuca - Plumas ivesia (SC)

Juncus leiospermus var. ahartii - Ahart's rush (SC)

Lampetra ayresi - river lamprey (SC)

Lampetra tridentata - Pacific lamprey (SC)

Legenere limosa - legenere (SC)

Lepus americanus tahoensis - Sierra Nevada snowshoe hare (SC)

Lewisia longipetala - long-petaled lewisia (SC)

Lewisia serrata - saw-toothed lewisia (SC)

Linderiella occidentalis - California linderiella fairy shrimp (SC)

Martes americana - American (=pine) marten (SC)

Martes pennanti pacifica - Pacific fisher (SC)

Megaleuctra sierra - Shirttail Creek stonefly (SC)

Myotis ciliolabrum - small-footed myotis bat (SC)

Myotis evotis - long-eared myotis bat (SC)

Myotis thysanodes - fringed myotis bat (SC)

Myotis volans - long-legged myotis bat (SC)

Myotis yumanensis - Yuma myotis bat (SC)

Nebria darlingtoni - South Forks ground beetle (SC)

Perognathus inornatus - San Joaquin pocket mouse (SC)

Phacelia stebbinsii - Stebbins' phacelia (SC)

Phrynosoma coronatum frontale - California horned lizard (SC)

Plegadis chihi - white-faced ibis (SC)

Rana boylii - foothill yellow-legged frog (SC)

Rana muscosa - mountain yellow-legged frog (SC)

Rhyacophila spinata - spiny rhyacophilan caddisfly (SC)

Riparia riparia - bank swallow (CA)

Sagittaria sanfordii - valley sagittaria (SC)

Scaphiopus hammondii - western spadefoot toad (SC)

Sidalcea stipularis - Scadden Flat checkermallow (CA)

Spirinchus thaleichthys - longfin smelt (SC)

Strix occidentalis occidentalis - California spotted owl (SC)

Vulpes vulpes necator - Sierra Nevada red fox (CA)

Wyethia reticulata - El Dorado mule-ears (SC)

Key:

(E) Endangered - Listed (in the Federal Register) as being in danger of extinction.

(T) Threatened - Listed as likely to become endangered within the foreseeable future.

(P) Proposed - Officially proposed (in the Federal Register) for listing as endangered or threatened.

(C) Candidate - Candidate to become a proposed species.

(D) Delisted - Species will be monitored for 5 years.

(SC) Species of Concern - Other species of concern to the Sacramento Fish & Wildlife Office.

Critical Habitat - Area essential to the conservation of a species.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

This is *not* an official list for formal consultation under the Endangered Species Act. *However, it may be used to update official lists.*

If you have a project that may affect endangered species, please contact the Endangered Species Division, Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service.

Federal Endangered and Threatened Species that may be affected by projects in Sacramento County

Database Last Updated: April 30, 2001
Today's Date is: July 31, 2001

Listed Species
Apodemia mormo langei - Lange's metalmark butterfly (E)

Arctostaphylos myrtifolia - Ione manzanita (T)

Branchinecta conservatio - Conservancy fairy shrimp (E)

Branchinecta lynchi - vernal pool fairy shrimp (T)

Castilleja campestris ssp. succulenta - fleshy owl's-clover (T)

Ceanothus roderickii - Pine Hill ceanothus (E)

Cordylanthus palmatus - palmate-bracted bird's-beak (E)

Desmocerus californicus dimorphus - valley elderberry longhorn beetle critical habitat (T)

Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)

Elaphrus viridis - delta green ground beetle (T)

Eriogonum apricum var. apricum - Ione buckwheat (E)

Eriogonum apricum var. prostratum - Irish Hill buckwheat (E)

Erysimum capitatum ssp. angustatum - Contra Costa wallflower (E)

Fremontodendron californicum ssp. decumbens - Pine Hill flannelbush (E)

Galium californicum ssp. sierrae - El Dorado bedstraw (E)

Haliaeetus leucocephalus - bald eagle (T)

Hypomesus transpacificus - delta smelt (T)

Hypomesus transpacificus - Critical habitat, delta smelt (T)

Lasthenia conjugens - Contra Costa goldfields (E)

Lepidurus packardi - vernal pool tadpole shrimp (E)

Neostapfia colusana - Colusa grass (T)

Neotoma fuscipes riparia - riparian (San Joaquin Valley) woodrat (E)

Oenothera deltoides ssp. howellii - Critical habitat, Antioch Dunes evening-primrose (E)

Oenothera deltoides ssp. howellii - Antioch Dunes evening-primrose (E)

Oncorhynchus mykiss - Central Valley steelhead (T)

Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)

Oncorhynchus tshawytscha - winter-run chinook salmon (E)

Oncorhynchus tshawytscha - Critical Habitat, Central Valley spring-run chinook (T)

Oncorhynchus tshawytscha - Critical habitat, winter-run chinook salmon (E)

Orcuttia tenuis - slender Orcutt grass (T)

Orcuttia viscida - Sacramento Orcutt grass (E)

Pogonichthys macrolepidotus - Sacramento splittail (T)

Rallus longirostris obsoletus - California clapper rail (E)

Rana aurora draytonii - Critical habitat, California red-legged frog (T)

Reithrodontomys raviventris - salt marsh harvest mouse (E)

Senecio layneae - Layne's butterweed (T)

Sylvilagus bachmani riparius - riparian brush rabbit (E)

Thamnophis gigas - giant garter snake (T)

Vulpes macrotis mutica - San Joaquin kit fox (E)

Proposed Species
Charadrius montanus - mountain plover (PT)

Candidate Species
Ambystoma californiense - California tiger salamander (C)

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)

Species of Concern
Acipenser medirostris - green sturgeon (SC)

Aegialia concinna - Ciervo aegialian scarab beetle (SC)

Agelaius tricolor - tricolored blackbird (SC)

Anniella pulchra pulchra - silvery legless lizard (SC)

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)

Anthicus sacramento - Sacramento anthicid beetle (SC)

Aster lentus - Suisun Marsh aster (SC)

Astragalus tener var. tener - alkali milk-vetch (SC)

Athene cunicularia hypugea - western burrowing owl (SC)

Atriplex cordulata - heartscale (SC)

Atriplex depressa - brittlescale (SC)

Atriplex joaquiniana - valley spearscale (SC)

Branta canadensis leucopareia - Aleutian Canada goose (D)

Buteo regalis - ferruginous hawk (SC)

Buteo Swainsoni - Swainson's hawk (CA)

Chlorogalum grandiflorum - Red Hills soaproot (SC)

Clemmys marmorata marmorata - northwestern pond turtle (SC)

Clemmys marmorata pallida - southwestern pond turtle (SC)

Coelus gracilis - San Joaquin dune beetle (SC)

Cophura hurdi - Antioch cophuran robberfly (SC)

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)

Efferia antiochi - Antioch efferian robberfly (SC)

Empidonax traillii brewsteri - little willow flycatcher (CA)

Eschscholzia rhombipetala - diamond-petaled poppy (SC)

Euderma maculatum - spotted bat (SC)

Eumops perotis californicus - greater western mastiff-bat (SC)

Falco peregrinus anatum - American peregrine falcon (D)

Grus canadensis tabida - greater sandhill crane (CA)

Horkelia parryi - Parry's horkelia (SC)

Hydrochara rickseckeri - Ricksecker's water scavenger beetle (SC)

Hygrotus curvipes - curved-foot hygrotus diving beetle (SC)

Idiostatus middlekaufi - Middlekauf's shieldback katydid (SC)

Juglans californica var. hindsii - Northern California black walnut (SC)

Juncus leiospermus var. ahartii - Ahart's rush (SC)

Lampetra ayresi - river lamprey (SC)

Lampetra hubbsi - Kern brook lamprey (SC)

Lampetra tridentata - Pacific lamprey (SC)

Laterallus jamaicensis coturniculus - black rail (CA)

Lathyrus jepsonii var. jepsonii - delta tule-pea (SC)

Legenere limosa - legenere (SC)

Lilaeopsis masonii - Mason's lilaeopsis (SC)

Linderiella occidentalis - California linderiella fairy shrimp (SC)

Masticophis flagellum ruddocki - San Joaquin coachwhip (=whipsnake) (SC)

Melospiza melodia maxillaris - Suisun song sparrow (SC)

Metapogon hurdi - Hurd's metapogon robberfly (SC)

Myotis ciliolabrum - small-footed myotis bat (SC)

Myotis evotis - long-eared myotis bat (SC)

Myotis thysanodes - fringed myotis bat (SC)

Myotis volans - long-legged myotis bat (SC)

Myotis yumanensis - Yuma myotis bat (SC)

Myrmosula pacifica - Antioch mutillid wasp (SC)

Nebria darlingtoni - South Forks ground beetle (SC)

Neotoma fuscipes annectens - San Francisco dusky-footed woodrat (SC)

Perdita hirticeps luteocincta - yellow-banded andrenid bee (SC)

Perdita scitula antiochensis - Antioch andrenid bee (SC)

Perognathus inornatus - San Joaquin pocket mouse (SC)

Philanthus nasilis - Antioch sphecid wasp (SC)

Phrynosoma coronatum frontale - California horned lizard (SC)

Plegadis chihi - white-faced ibis (SC)

Rana boylii - foothill yellow-legged frog (SC)

Riparia riparia - bank swallow (CA)

Sagittaria sanfordii - valley sagittaria (SC)

Scaphiopus hammondii - western spadefoot toad (SC)

Sorex ornatus sinuosus - Suisun ornate shrew (SC)

Spirinchus thaleichthys - longfin smelt (SC)

Wyethia reticulata - El Dorado mule-ears (SC)

Key:

(E) Endangered - Listed (in the Federal Register) as being in danger of extinction.

(T) Threatened - Listed as likely to become endangered within the foreseeable future.

(P) Proposed - Officially proposed (in the Federal Register) for listing as endangered or threatened.

(C) Candidate - Candidate to become a proposed species.

(D) Delisted - Species will be monitored for 5 years.

(SC) Species of Concern - Other species of concern to the Sacramento Fish & Wildlife Office.

Critical Habitat - Area essential to the conservation of a species.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

This is *not* an official list for formal consultation under the Endangered Species Act. *However, it may be used to update official lists.*

If you have a project that may affect endangered species, please contact the Endangered Species Division, Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service.

FEDERAL AGENCIES' RESPONSIBILITIES UNDER
SECTIONS 7(a) AND (c) OF THE ENDANGERED SPECIES ACT

Section 7(a): Consultation/Conference

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species; 2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded, or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the Federal agency after determining the action may affect a listed species; and 3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat.

Section 7(c): Biological Assessment - Major Construction Activity[1]

Requires Federal Agencies or their designees to prepare a Biological Assessment (BA) for major construction activities. The BA analyzes the effects of the action[2] on listed and proposed species. The process begins with a Federal agency requesting from FWS a list of proposed and listed threatened and endangered species. The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the list, the accuracy of the species list should be verified with the Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may proceed; however, no construction may begin.

We recommend the following for inclusion within the BA: an on-site inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species or suitable habitat are present; a review of literature and scientific data to determine species' distribution, habitat needs, and other biological requirements; interviews with experts, including those within FWS, State conservation departments, universities, and others who may have data not yet published in scientific literature; an analysis of the effects of the proposal on the species in terms of individuals and populations, including consideration of indirect effects of the proposal on the species and its habitat; an analysis of alternative actions considered. The BA should document the results, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not a listed or proposed species will be affected. Upon completion, the BA should be forwarded to our office.

---

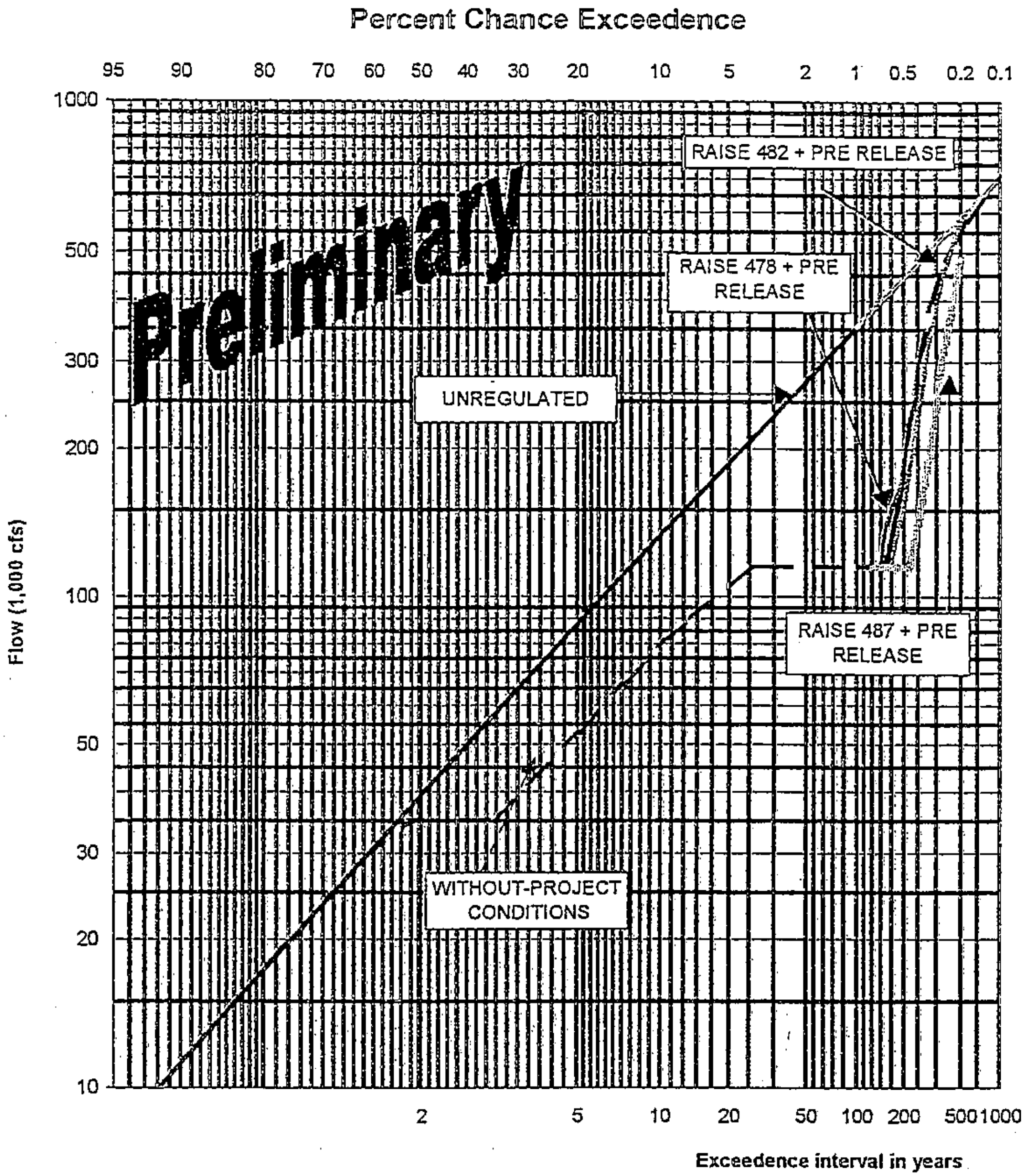
[1]A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332(2)C).

[2]"Effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action.

APPENDIX D

AMERICAN RIVER WATERSHED INVESTIGATION
FOLSOM DAM ENLARGEMENT PLAN

PRELIMINARY FLOW-FREQUENCY PLOTS AND FLOOD ROUTINGS FOR THE FOLSOM DAM RAISE ALTERNATIVES



Without Project

Raise 478 + Pre Release

Raise 482 + Pre Release

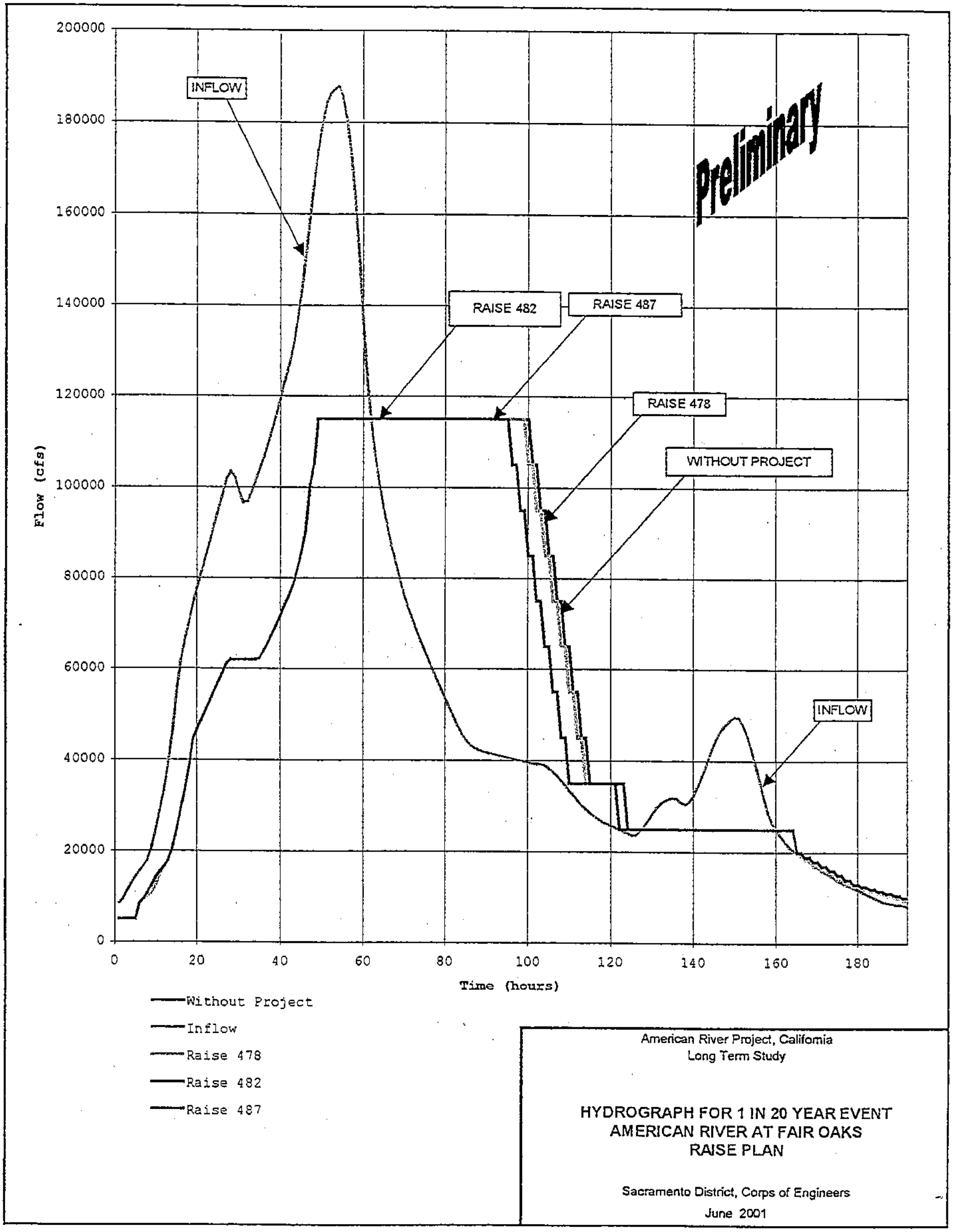
Raise 487 + Pre Release

American River Project, California
Long Term Study

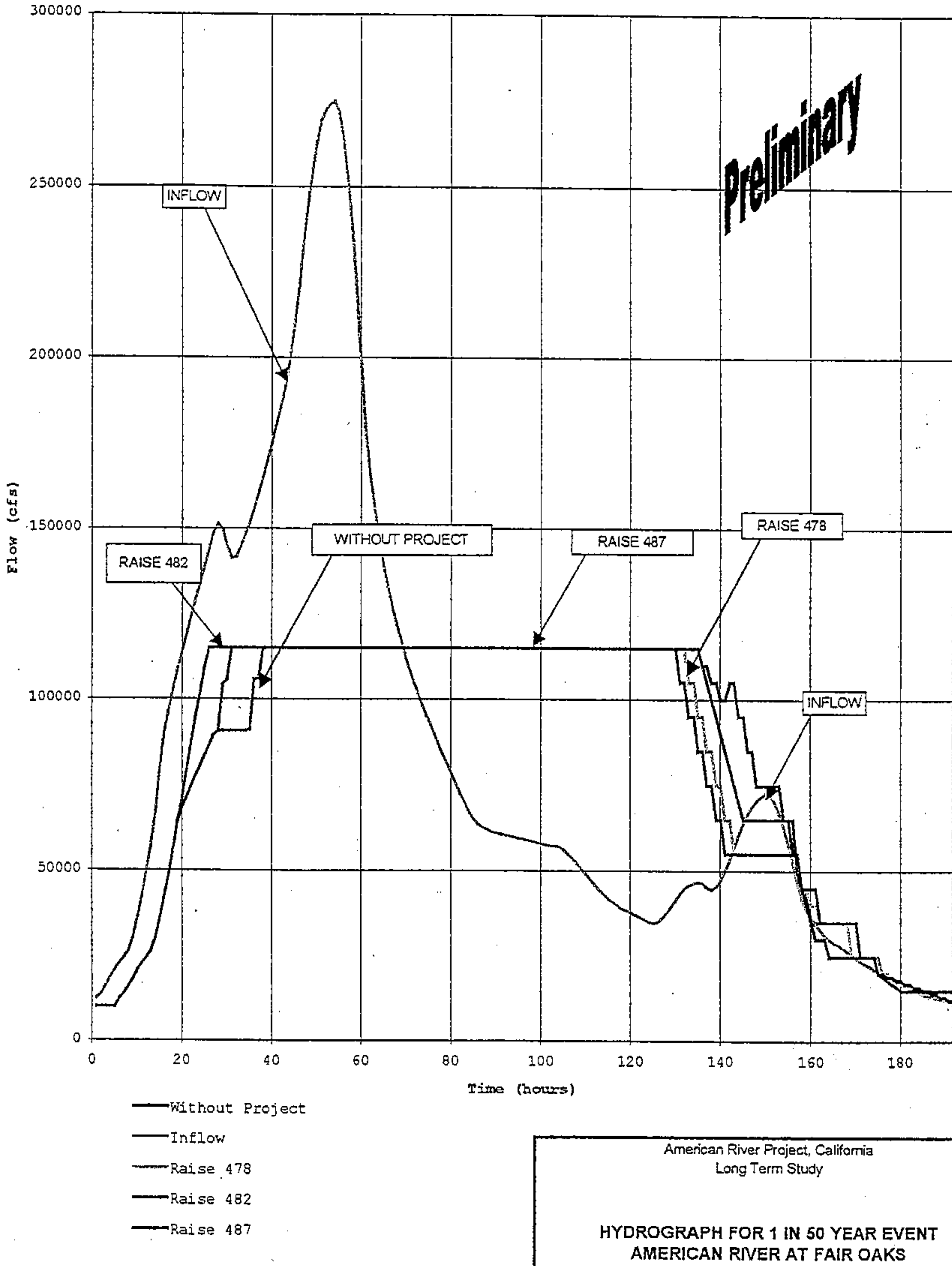
F4 Conference and Alternative Formulation Briefing Document

FREQUENCY CURVES
AMERICAN RIVER AT FAIR OAKS
RAISES WITH PRE-RELEASE

Sacramento District, Corps of Engineers



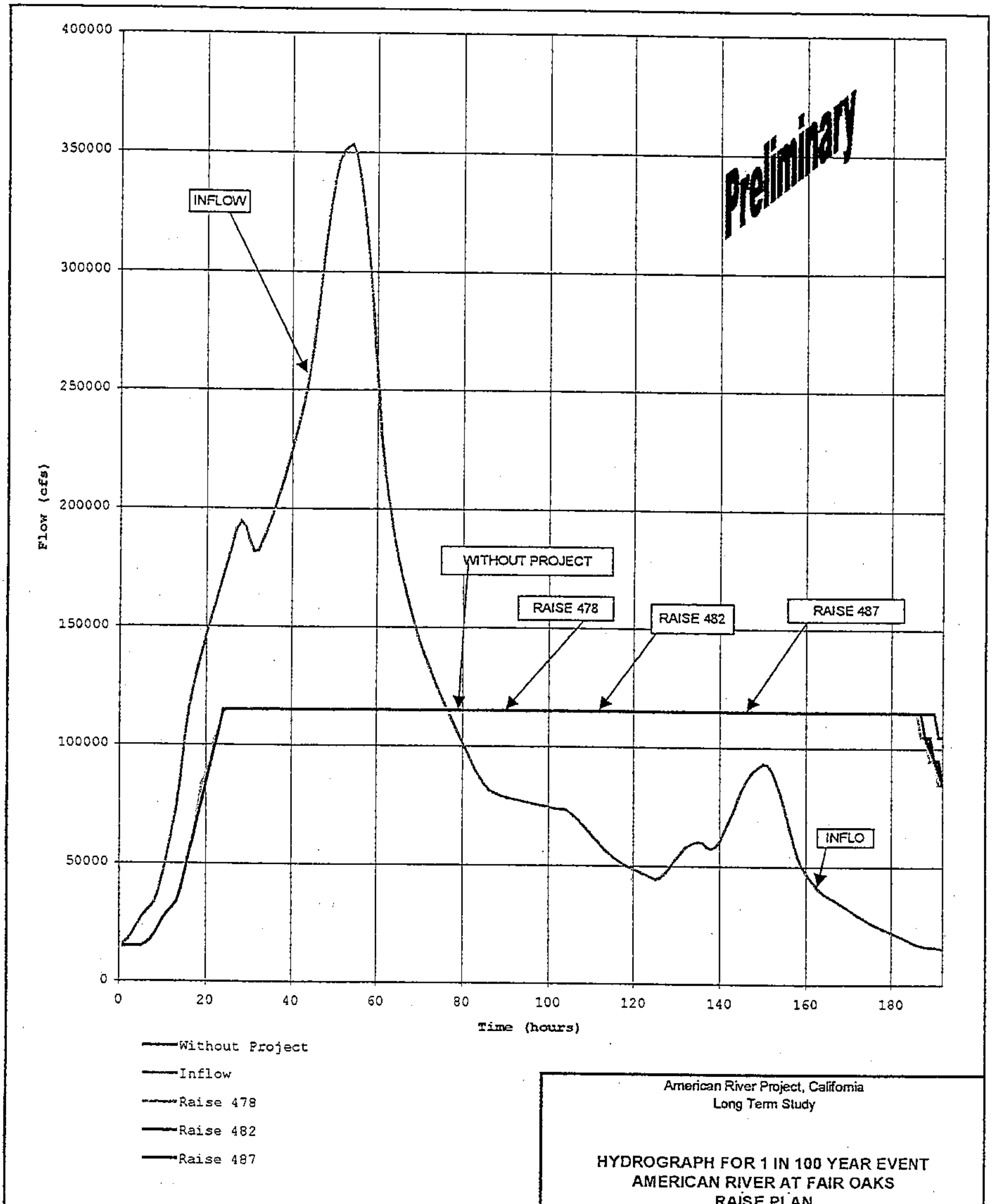
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
Flow (cfs)
0
20
40
60
80
100
120
140
160
180
Time (hours)
INFLOW
Preliminary
RAISE 482
RAISE 487
RAISE 478
WITHOUT PROJECT
INFLOW
Without Project
Inflow
Raise 478
Raise 482
Raise 487
American River Project, California
Long Term Study
HYDROGRAPH FOR 1 IN 20 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN
Sacramento District, Corps of Engineers
June 2001



American River Project, California
Long Term Study

HYDROGRAPH FOR 1 IN 50 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN

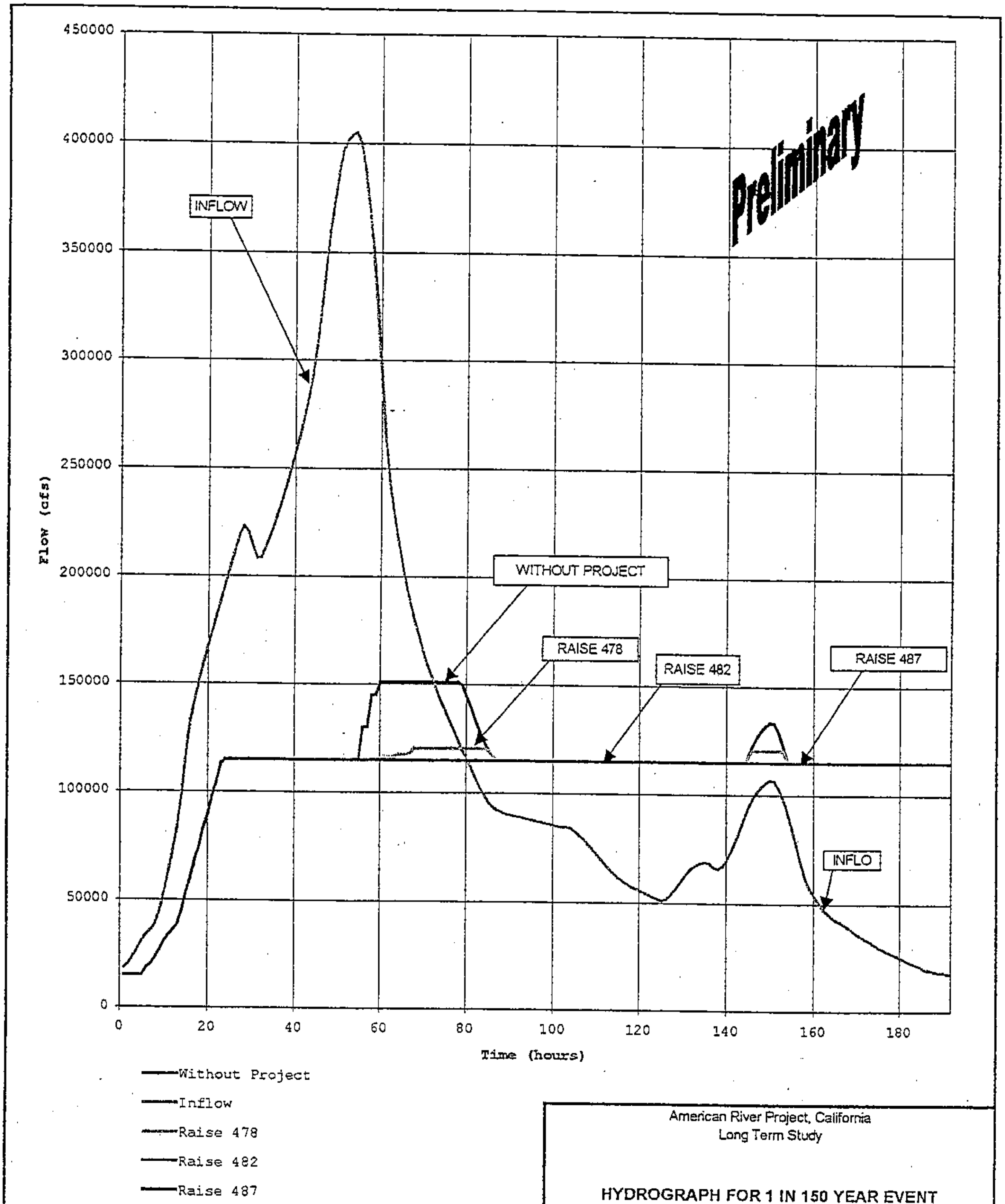
Sacramento District, Corps of Engineers
June 2001



American River Project, California
Long Term Study

**HYDROGRAPH FOR 1 IN 100 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN**

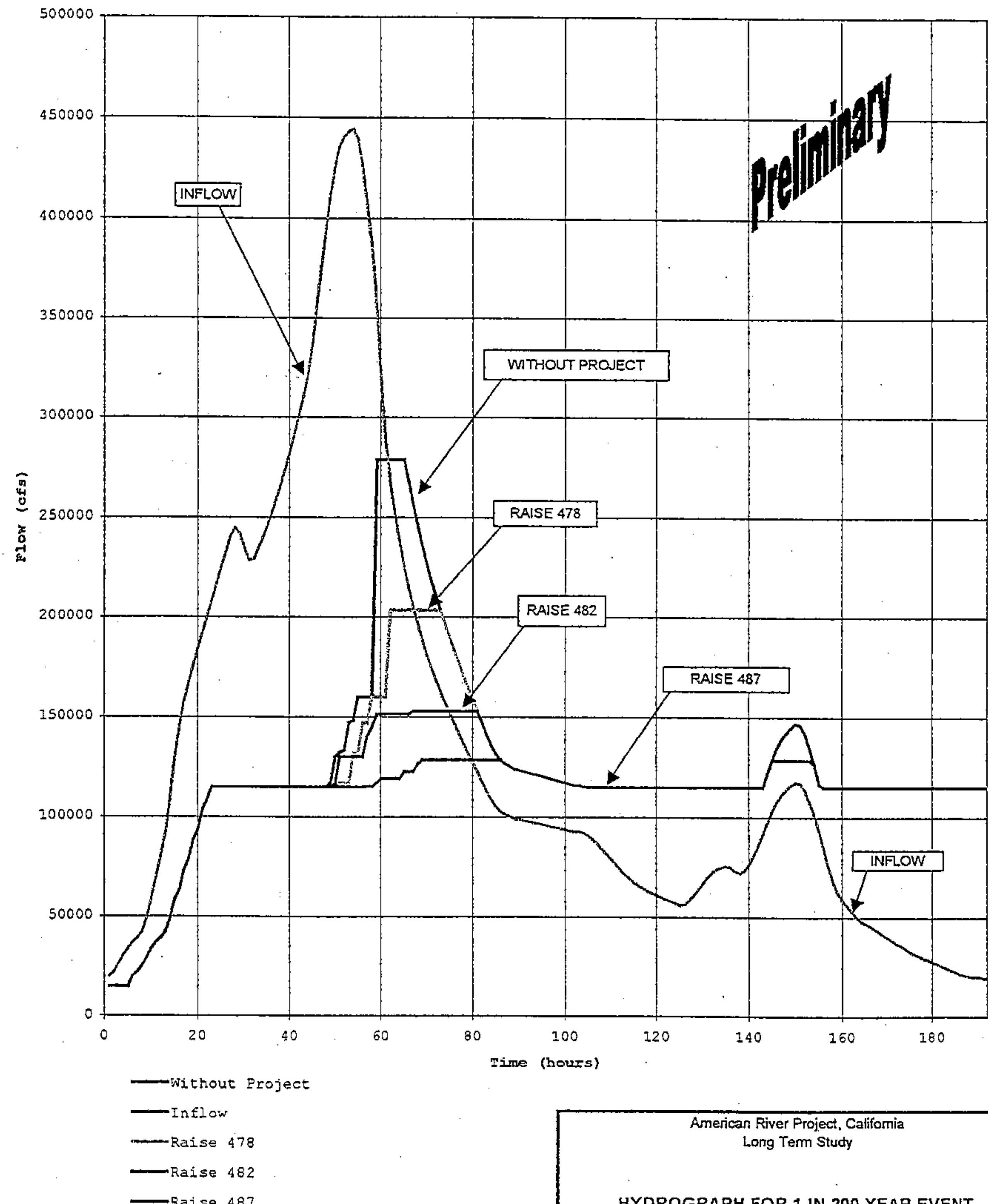
Sacramento District, Corps of Engineers
June 2001



American River Project, California
Long Term Study

HYDROGRAPH FOR 1 IN 150 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN

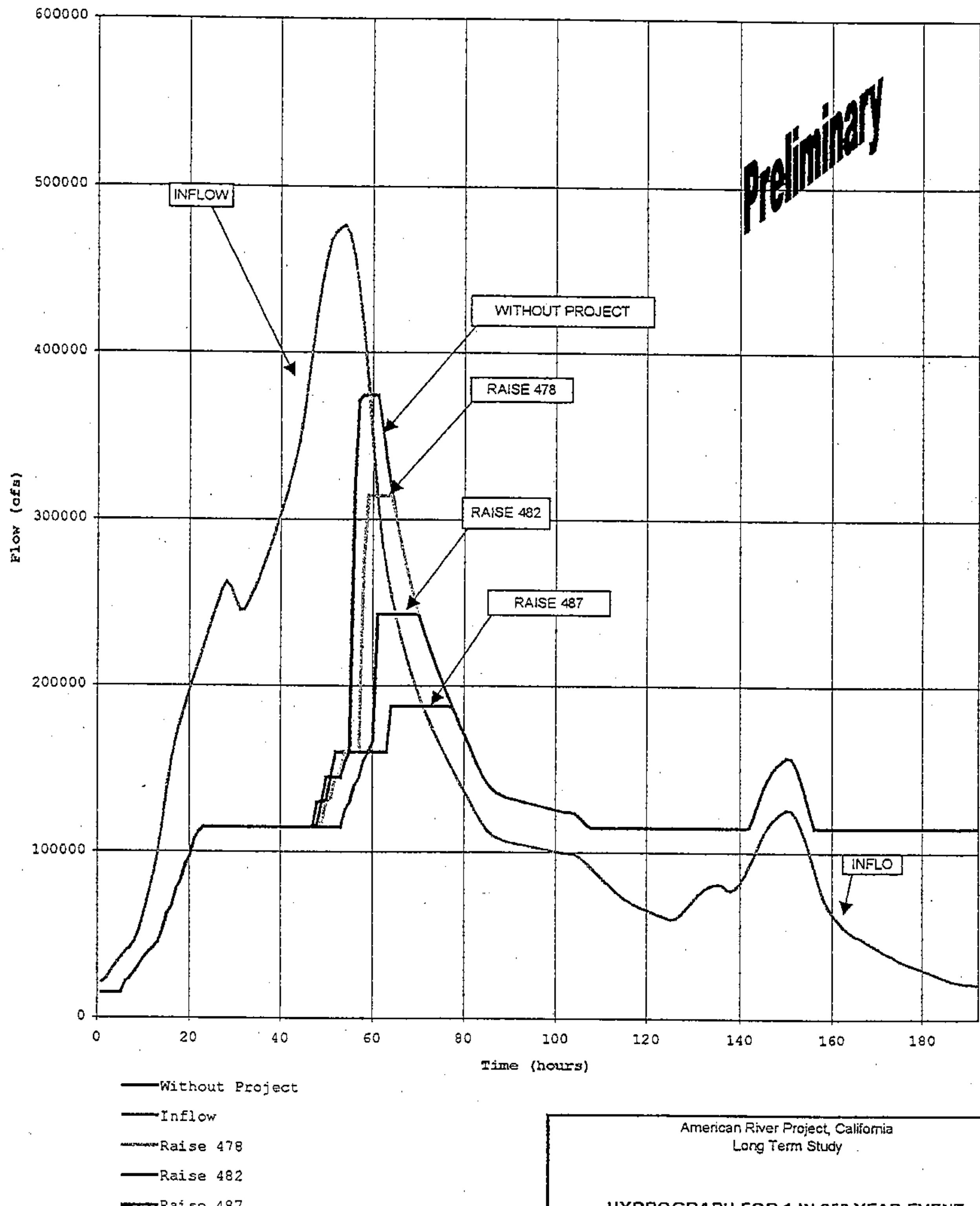
Sacramento District, Corps of Engineers
June 2001



American River Project, California
Long Term Study

HYDROGRAPH FOR 1 IN 200 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN

Sacramento District, Corps of Engineers
June 2001

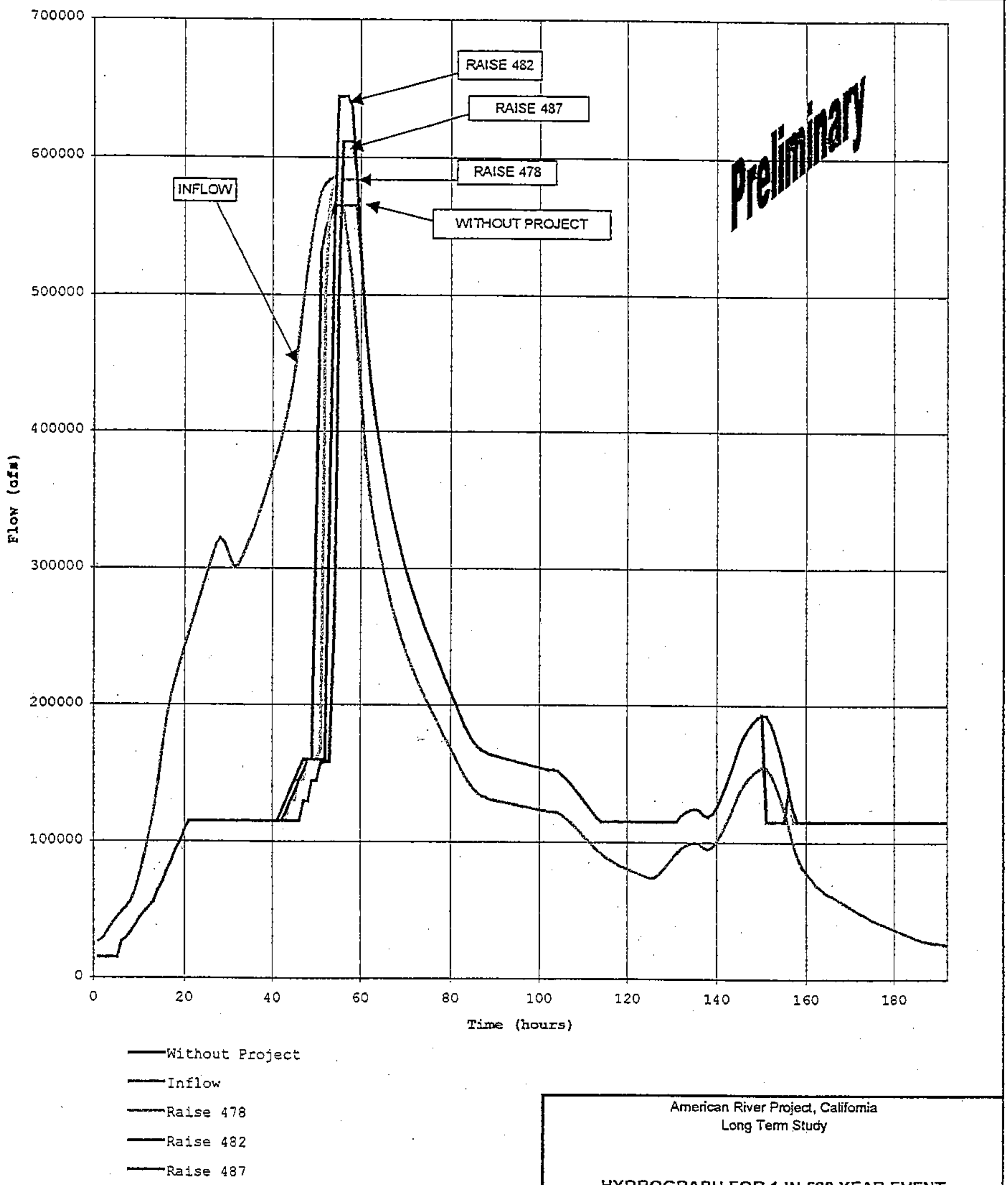


American River Project, California
Long Term Study

**HYDROGRAPH FOR 1 IN 250 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN**

Sacramento District, Corps of Engineers
June 2001

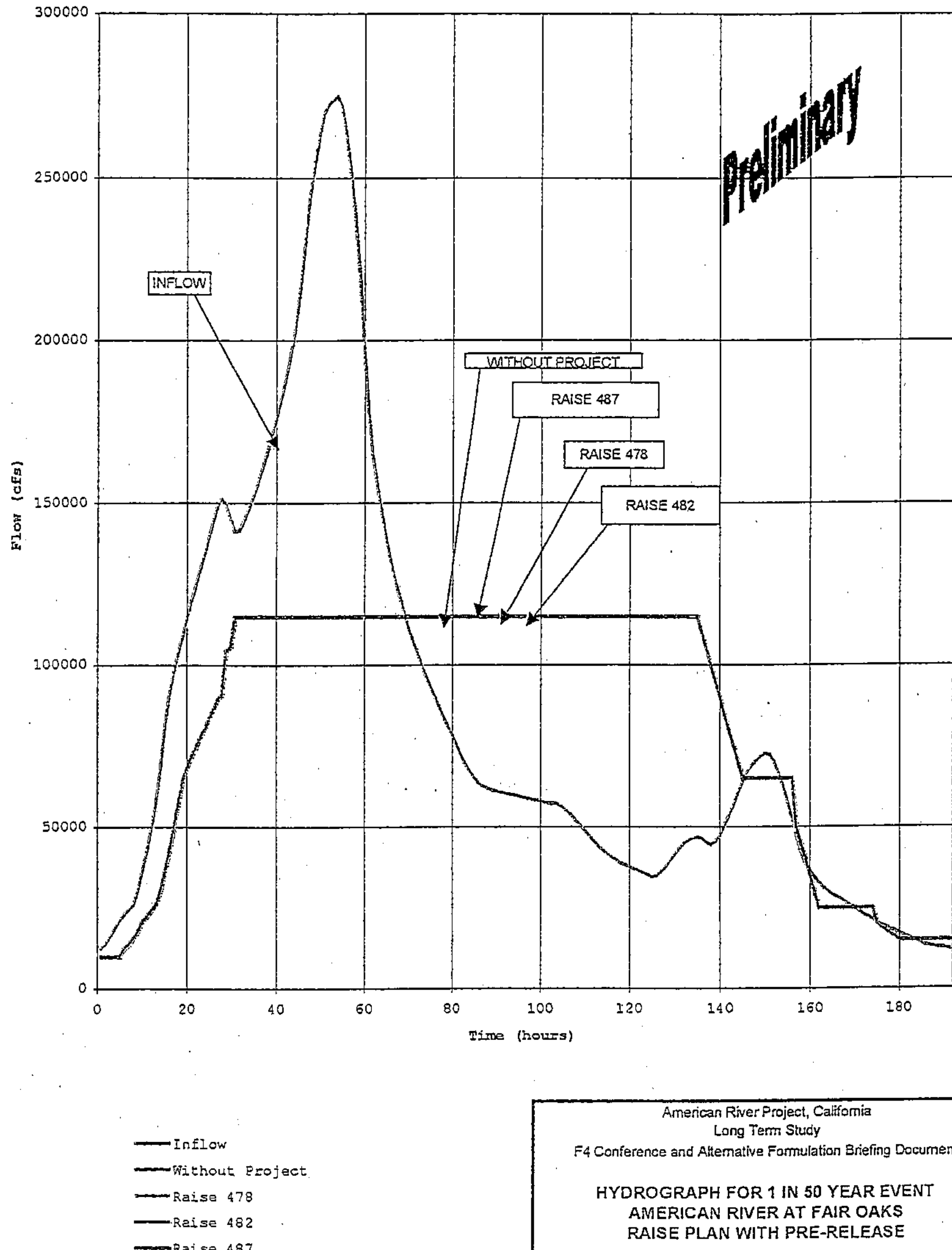
Steve



American River Project, California
Long Term Study

HYDROGRAPH FOR 1 IN 500 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN

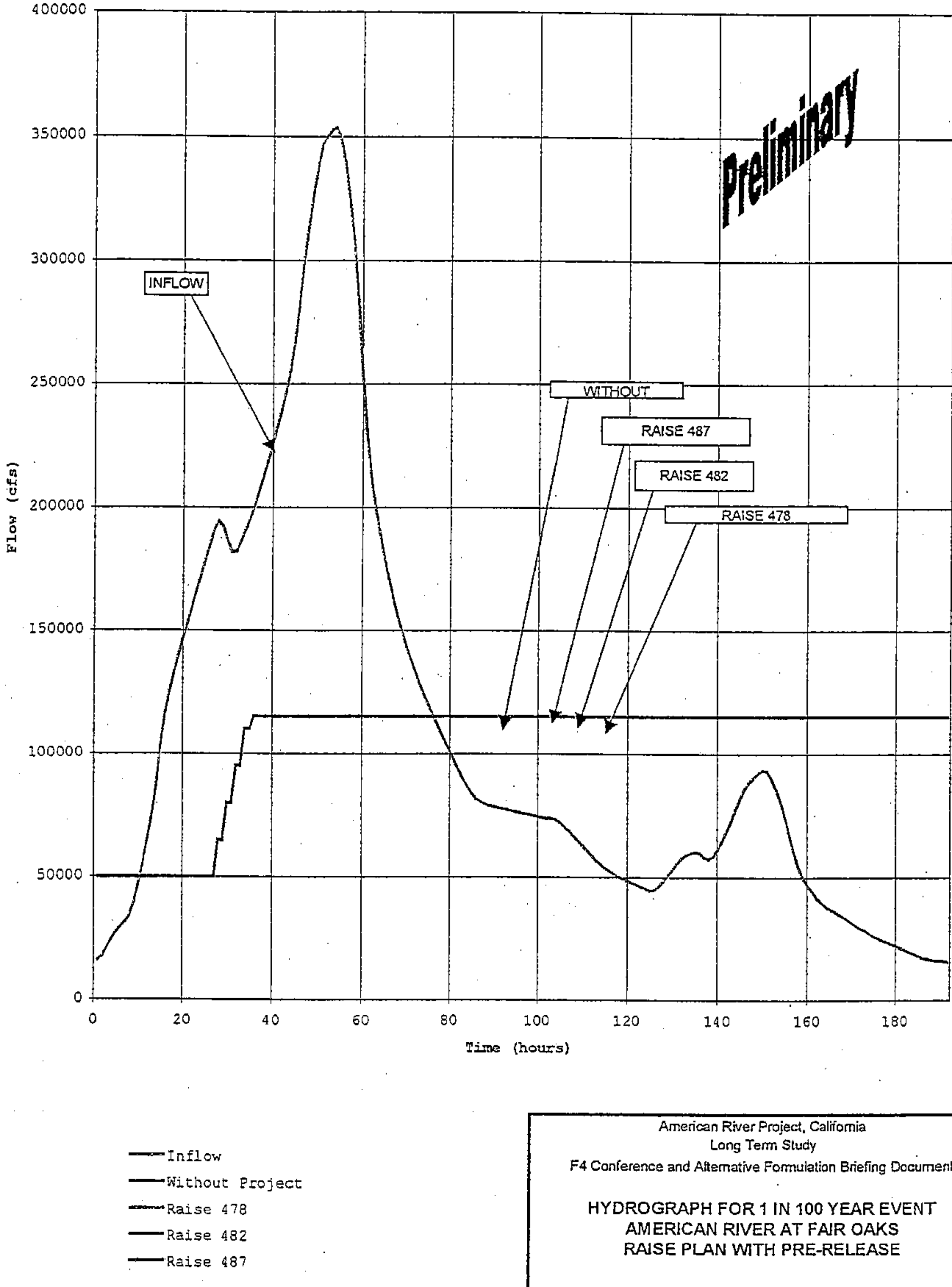
Sacramento District, Corps of Engineers
June 2001



American River Project, California
Long Term Study
F4 Conference and Alternative Formulation Briefing Document

HYDROGRAPH FOR 1 IN 50 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN WITH PRE-RELEASE

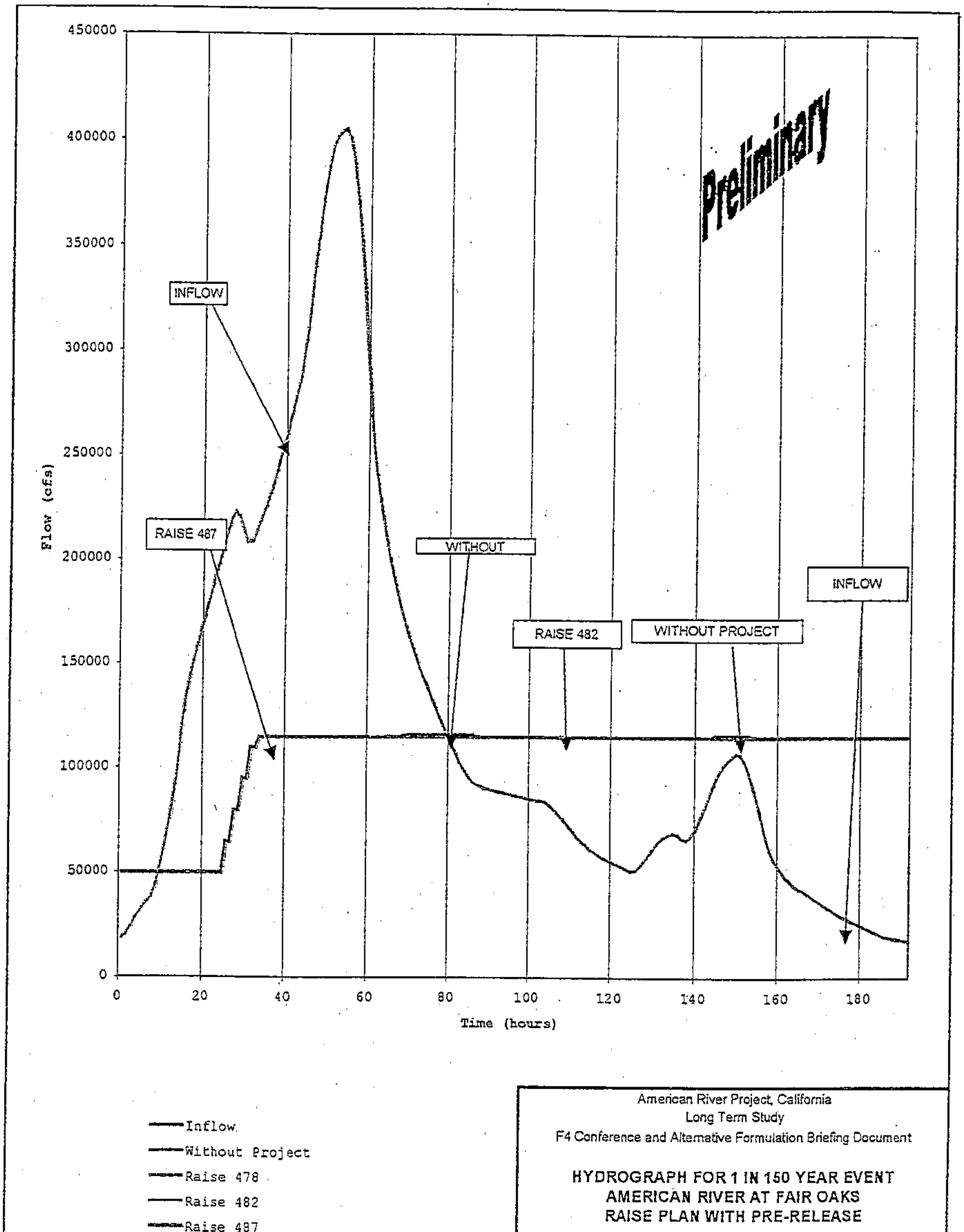
Sacramento District, Corps of Engineers
May 2001



American River Project, California
Long Term Study
F4 Conference and Alternative Formulation Briefing Document

HYDROGRAPH FOR 1 IN 100 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN WITH PRE-RELEASE

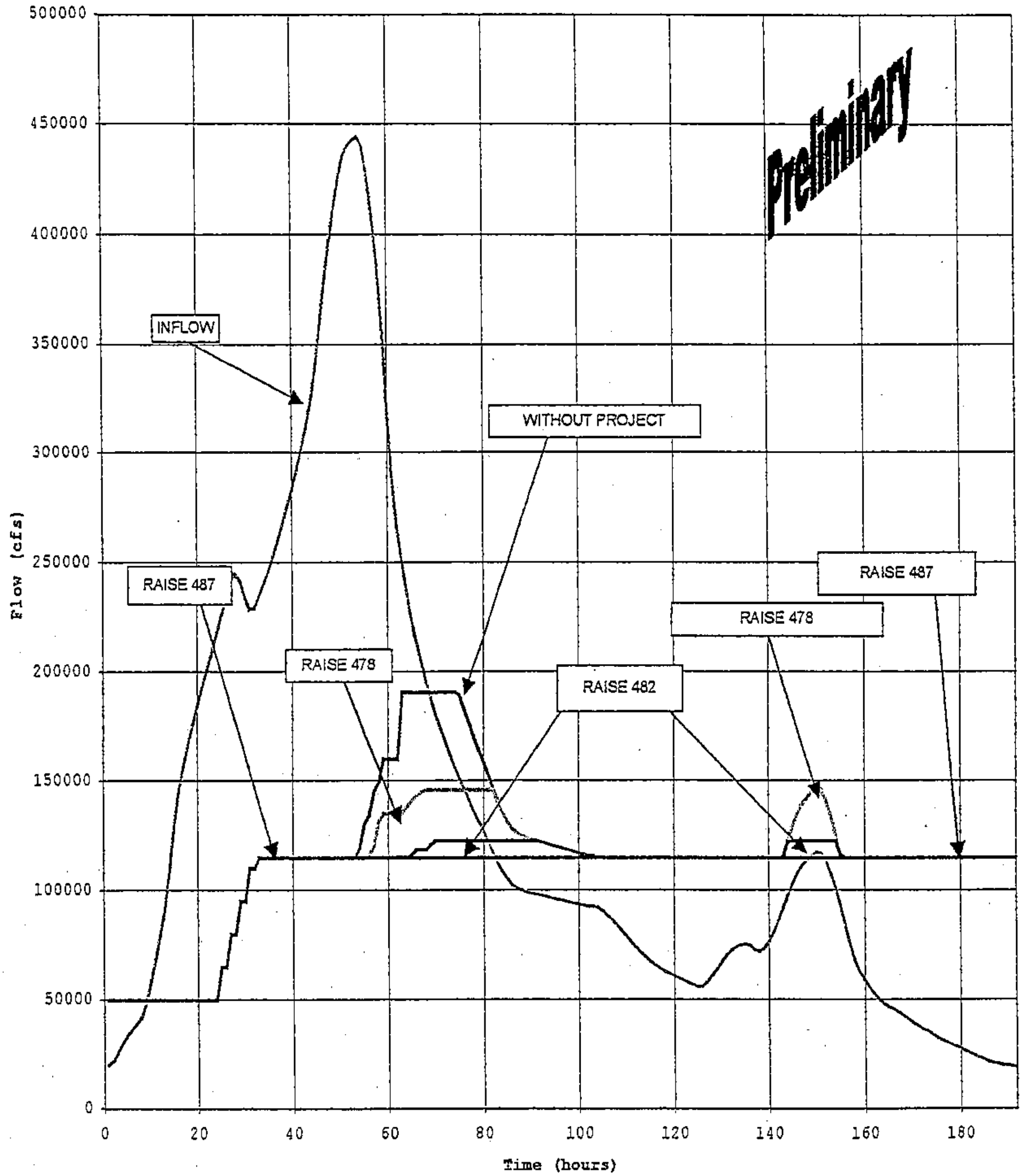
Sacramento District, Corps of Engineers
May 2001



American River Project, California
Long Term Study
F4 Conference and Alternative Formulation Briefing Document

HYDROGRAPH FOR 1 IN 150 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN WITH PRE-RELEASE

Sacramento District, Corps of Engineers
May 2001



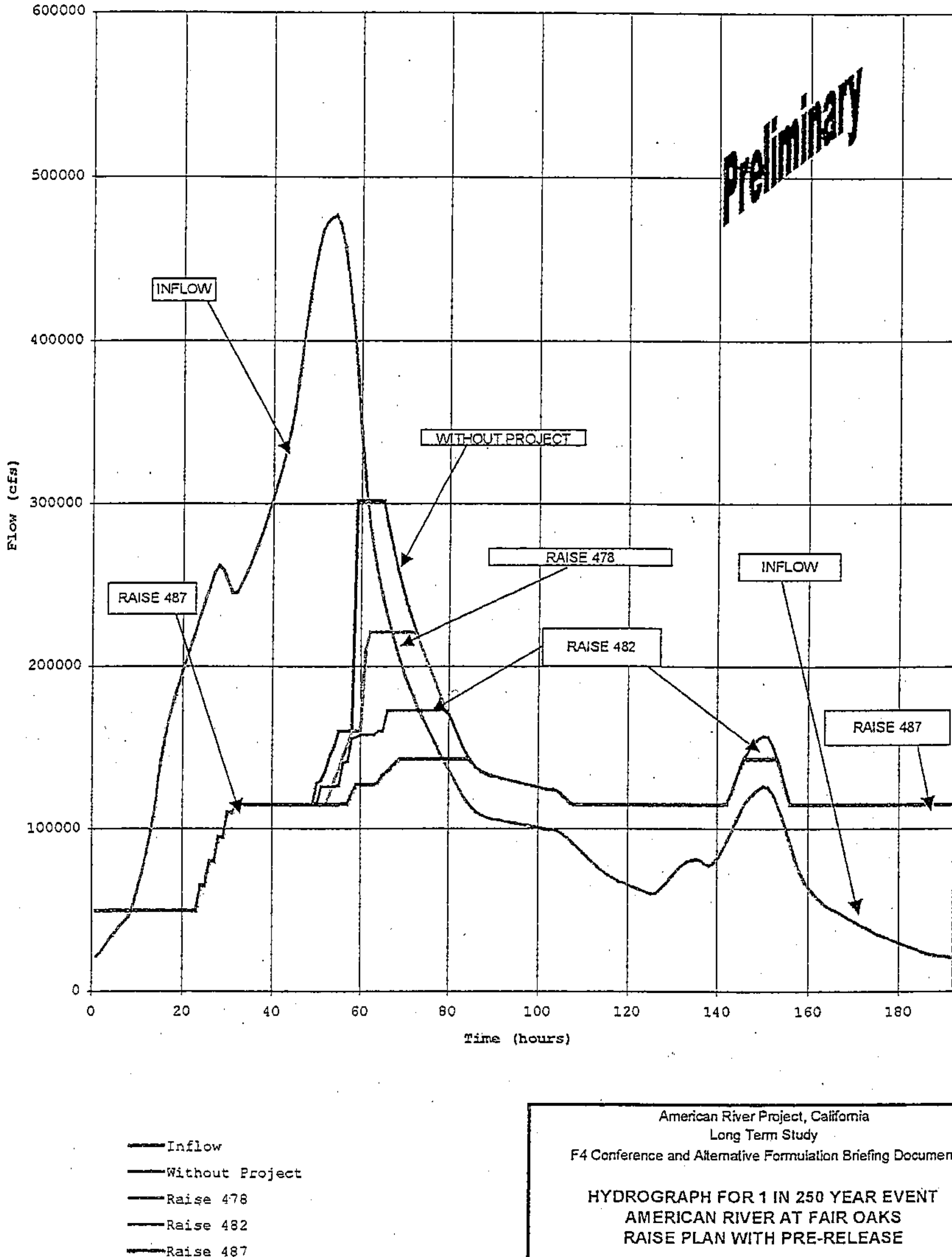
Inflow
Without Project
Raise 478
Raise 482
Raise 487

American River Project, California
Long Term Study
F4 Conference and Alternative Formulation Briefing Document

HYDROGRAPH FOR 1 IN 200 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN WITH PRE-RELEASE

Sacramento District, Corps of Engineers

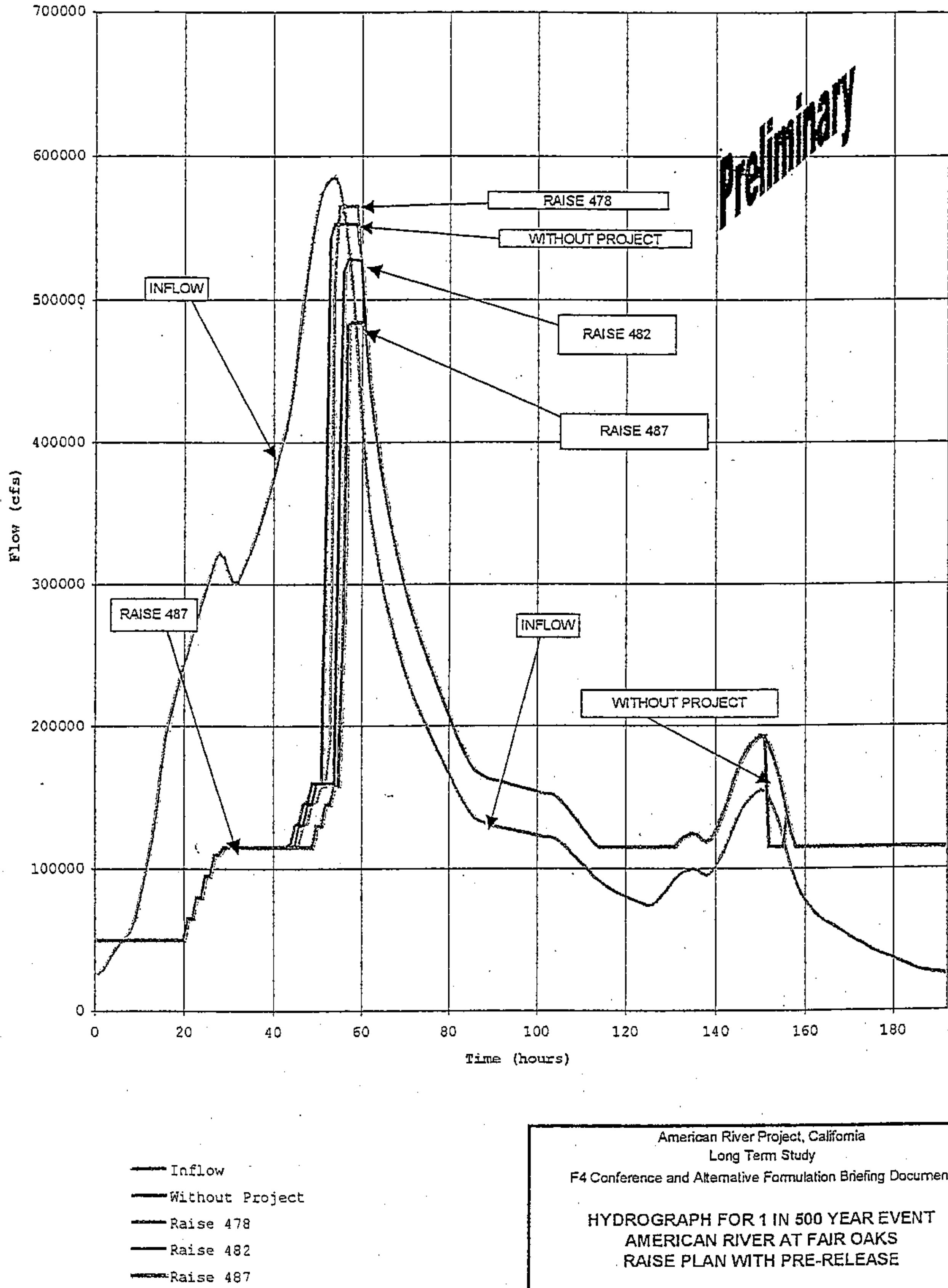
8-May-01



American River Project, California
Long Term Study
F4 Conference and Alternative Formulation Briefing Document

HYDROGRAPH FOR 1 IN 250 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN WITH PRE-RELEASE

Sacramento District, Corps of Engineers
May 2001



American River Project, California
Long Term Study
F4 Conference and Alternative Formulation Briefing Document

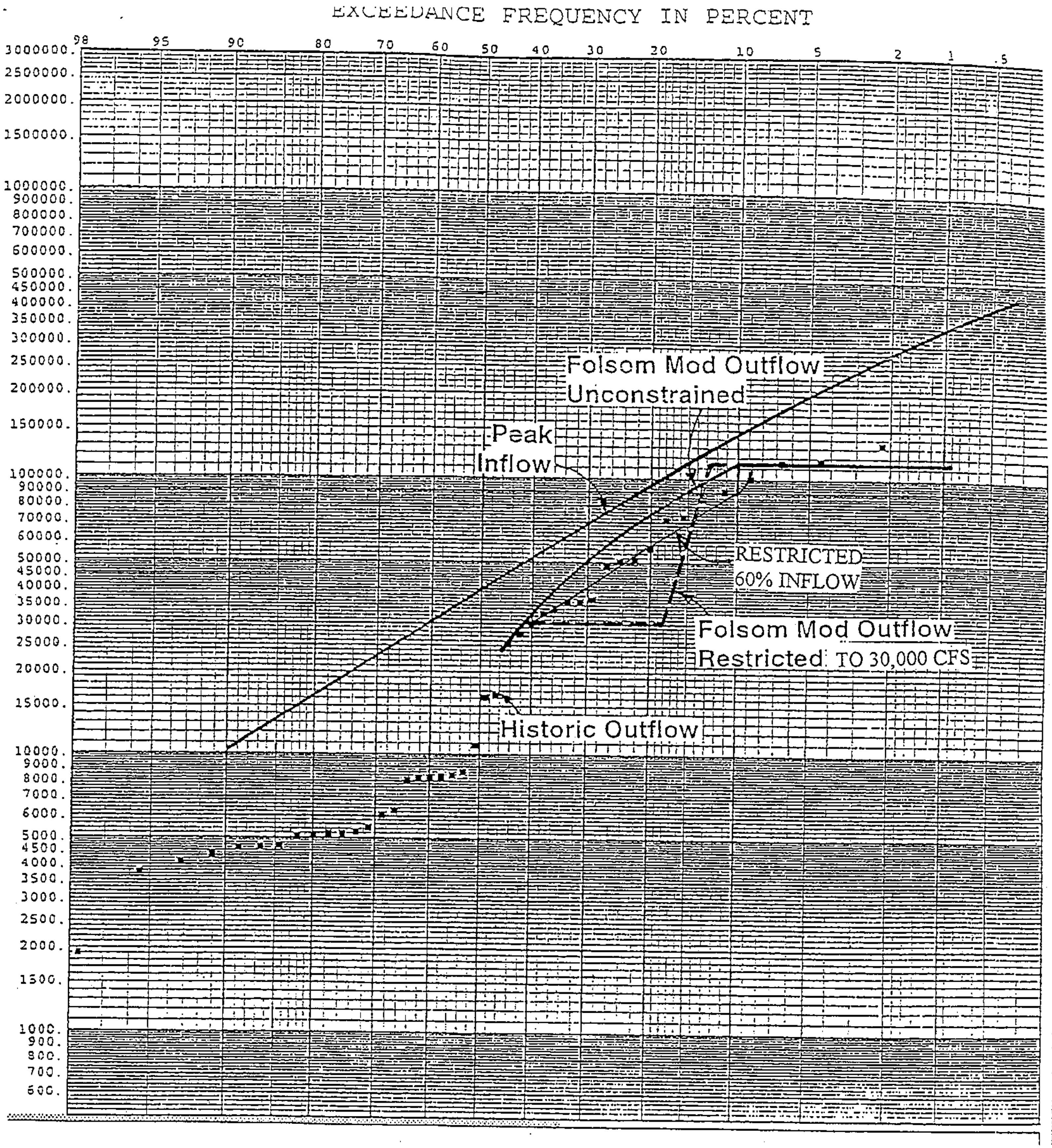
HYDROGRAPH FOR 1 IN 500 YEAR EVENT
AMERICAN RIVER AT FAIR OAKS
RAISE PLAN WITH PRE-RELEASE

Sacramento District, Corps of Engineers
May 2001

APPENDIX E

AMERICAN RIVER WATERSHED INVESTIGATION
FOLSOM DAM ENLARGEMENT PLAN

FLOW-FREQUENCY PLOT FOR THE
FOLSOM DAM OUTLET MODIFICATION PROJECT



Plot of peak inflow and outflow for potential project operations (unconstrained, 30,000 cfs restriction, or 60% of inflow restriction) against exceedence frequency for Folsom Reservoir (MBK Engineers, Joe Countryman, September 2000).